"THE FAR EASTERN REVIEW" – CHINESE RAILWAY CONSTRUCTION

A COMPREHENSIVE STUDY OF HISTORICAL REFERENCES WITHIN THE LIFE OF THIS JOURNAL OF THE DEVELOPMENT & CONSTRUCTION OF CHINA'S EARLY RAILWAYS, INCLUDING EXTRACTS OF RELEVANT PAGES
(SECTION 12(a) of 14)

For Introduction please see preface to Volumes I - V

(Note : to view the relative pages of the magazine, scroll down to end of these notes for each volume, respectively)

Volume XXIX

January 1933
Economics of Light Railways for China An in-depth 12-page comparative study by Consulting Engineer Arthur M Shaw about economies which can be realized by using light railways such as the Hangchow-Kiangshan Railway. (see FER October 1932 edition for description by same author)
Engineering Notes: -
Railway Loans A Shanghai syndicate had agreed to provide a loan for the completion of the Hangchow- Kiangshan railway.
A 32$ million loan had been agreed for redemption of the Japanese mortgage on the Kiaochow-Tsinan Railway.
£2.4 million in bonds were to be floated for the Chuchow- Shanchow section of the Canton-Hankow Railway.
Take Over Line - The Chinese authorities were to take control of the Cheng - Tai Railway from the French.
Lung-Hai Railway Work Laying of tracks had commenced on the eastern extension of this line to Hsukow on the Kiangsu coast.
Chinese Light Railways the National Reconstruction Commission was contemplating constructing two light railways.

February 1933
Purchasing for the S.M.R. A short description of the Dairen -based Purchasing Department of the South Manchuria Railway Company.
Engineering Notes:-
Building Bridges - Construction of bridges on the Shiuchow-Lokching section of the Canton-Hankow Railway were expected to be completed by May. Ralway in Manchoukuo Since the takeover of Manchuria by the Japanese, the proposed new line to the Korean frontier was progressing. This had been opposed by the former Chinese Manchurian government in Mukden.

March 1933

New Canton Bridges A third new bridge across the Pearl river was to be built jointly by the Canton Municipality and the Canton-Hankow Railway.

Notable New Locomotives for China An illustrated description of eight new 2-8-2 locomotives built by Nasmyth Wilson & Co. of Manchester for Chinese Government Railways. They had been shipped fully erected on 14 December in 1932. 2 photos and 1 drawing.

Engineering Notes:-

Railway Work in China The completion target for the Canton-Hankow Railway had been shortened from 11 to 3 years.

Lung-Hai Line Outlet With the completion of a line from Haichow to the new Hsuchow harbour, the railway was hoping to develop freight traffic.

April 1933

The Canton-Hankow Railway A report claiming the Ministry of Railway's goal for completion of the 700-mile line had been set as four years.

May 1933

Railway Contruction Pushed by Manchoukuo A report detailing how the Tai' an-Koshan-Tungpei-Hailun Line and link between the Tunhua and Korea was intended to be ready for operation in time for handling the autumn harvest. [Tai'an (泰安 – Keshan (克山) -Tungpei (Bei'an 北安)-Hailun 海伦] & Tunhua (Dunhua 敦化). 1 map and some statistics.

Engineering Notes:

Proposed New Line The Kiangsu Department of Reconstruction had proposed a new railway linking Haichow (海州) with Tungchow (通州) bar near the mouth of the Yangtze.

Orders for England $1.9 million had been set aside for purchasing locomotives & rolling stock for the Canton -Shaokwan and Canton-Samshui lines.

Light Railway a light railway was planned between Wuhu and Chapoo (乍浦)

Material Arrives - Reported that railway materials purchased by the Ministry of Railways for the construction of the Chuchow-Shiuchow section of the Canton-Hankow Railway had arrived from England.

Survey Planned The Kiangsi Provincial Department of Reconstruction was loaning engineers from to survey a proposed Nanchang-Kiangshan Railway line.

Proposed Railway The construction of a light railway as an ex-tension of the Canton-Samshui Railway to the port of Wuchow in S.E. Kwangsi had been decided at a meeting of the South-western Political Affairs Committee.

Planed Expansion A plan to double track part of the Nanking-Shanghai Railway line between Chinkiang , Nanking , Soochow , and Shanghai was being considered by the Ministry of Railways.

The Minister of Railways had reportedly approached local bankers for raising of $4 million for the project.

Link Lines In China - The Canton authorities were willing to link up the Kowloon-Canton Railway with the Canton-Hankow Railway by a loop-line at Canton if a foreign development loan of $15 million was forth-coming .

June 1933

Manchukuo and Engineering Developments An in-depth illustrated report about industrial recent development in Manchoukuo. One section describes

railway development. Several line-side photos as well pictures of the Shakako railway workshops etc.
Railway Schemes in Shansi . Discussions were proceeding on whether to construction the Tung-Pu Line (同蒲铁路) as meter gauge track to avoid transshipment of cargo with the Cheng-Tai Line.

Juy 1933
The Nanking - Pukow Train Ferry – An illustrated description of the almost completed Nanking-Pukow train ferry and bridge terminals. The first train ferry, “Chang-kiang”, built in Britain, had aready been delivered some months earlier.
Hasler Telegraph Works – Small advertisement for locomotive speed indicators & recorders .

August 1933
New Railway Station for Shanghai - Plans had been drafted for construction of a new railway station to accommodate the headquarters of the Shanghai- Nanking and Shanghai-Hangchow Railway Administration in place of the North Station which had been partially destroyed by Japanese bombardment during the Sino-Japanese hostilities of 28 January 1932.

September 1933
Modern Traction in Siam and Manchuria An illustrated description of Sulzer diesel locomotives & railcars introduced in Siam (Thailand) and on the South Manchuria Railway. 3 photographs.

October 1933
The Manchurian Railway System An extract from the Railway Gazette describing the relationship between the South Manchurian Railway and the Manchoukuo Government. 1 small map.
The Nankow Pass on the Peiping -Suiyuan Railway T. King, the Chief Engineer describes the construction of the line and pass I which began in 1905 under the direction of the late Jeme Tien Yu. 1 small sketch map & several drawings and tables. (six pages in total) .
Engineering Notes
Manchoukuo Railway. Local inhabitants Paotsing district had petitioned the authorities to construct a railway from Lishuchen to Paotsing.
Kangsi Railway Scheme - a project for the construction of a railway between Yushan and Pinghsiang, in Kiangsi, was under consideration.
New Kwangsi Railway - Preparations for the construction of the Samshui-Hohsien railway, an extension of the Canton-Samshui Railway, were making substantial progress.
Locomotives Ordered -The Hunslet Engine Company of Leeds had been commissioned to build six locomotives for the Hongchow-Kiangshan Railway.

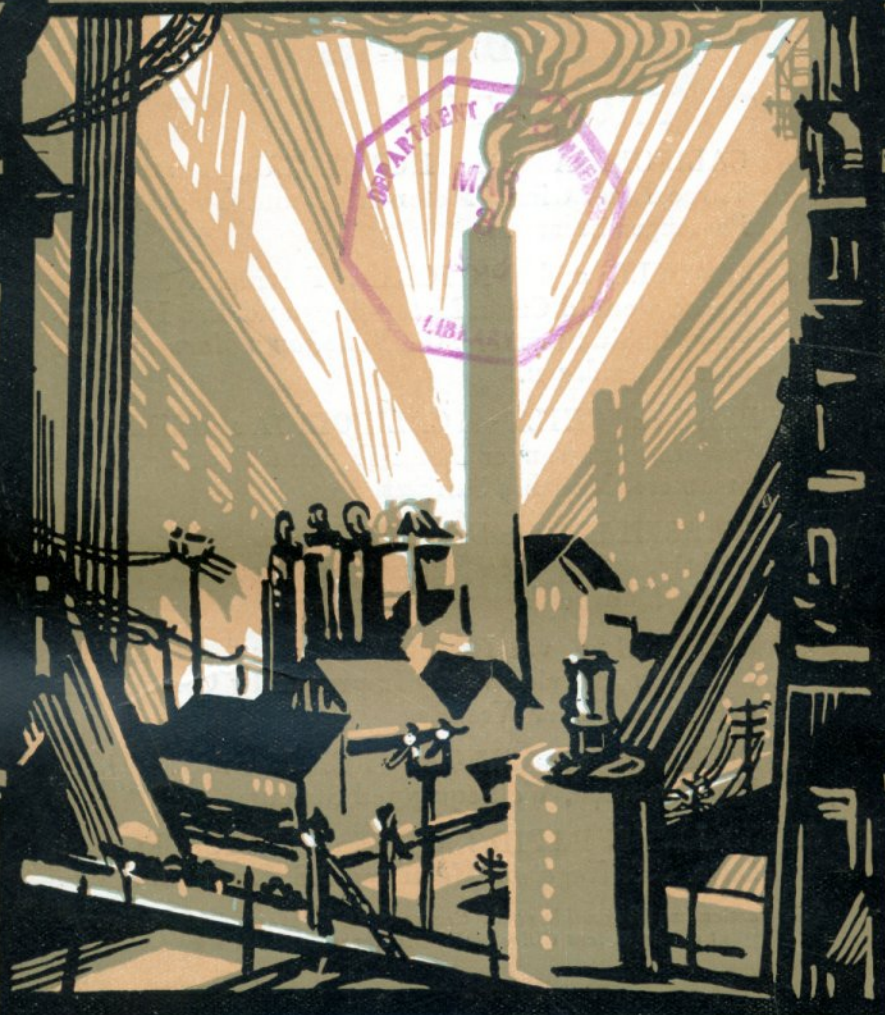
November 1933
Engineering Notes
New Railway in Manchuria -The Manchoukuo communication authorities were starting to build an “important railway”, 268 km long, to link Harbin and Lafa (拉发) in northern Manchuria.
Indo-China Ralway -the French authorities were considering the electrification of several railways in their Indo-China colonies.
Shansi Railway Extension A report that Yen Hsi-shan,Governor of Shansi, had invited tenders from European firms for supplying equipment for the first section of the Tung-Pu Railway

December 1933
Railway Constuction in Hunan Reported that $6.6 million was to be spent on constructing the Paoking-Hungkiang light railway in Hunan Province.

/continued on page 206

ENGINEERING FINANCE COMMERCE

THE FAR EASTERN REVIEW



上海黃浦灘念四號

遠東時報

MANCHUKUO

By GEORGE BRONSON REA

What Price Postal Bans—Boycotts—Warfare?

JEHOL PROVINCE

Vol. XXIX | JANUARY, 1933 | No. 1

Economics of Light Railways for China

By ARTHUR M. SHAW, Consulting Engineer

FOREWORD.—In presenting the case for light, standard-gauge railways, Colonel Shaw has given us material, in his "Economics of Light Railways for China," which not only is interesting and informative, but which is highly valuable and most timely; while his specific example of the Hangchow-Kiangshan Railway gives a most practical turn to the principles advocated.

First and foremost, to the general reader, this work shows how and why China remains in a state of economic under-development, especially in regard to means for inland transportation. He also suggests a concrete, workable plan for increasing her railway mileage at a minimum cost, for immediate future use, and in spite of the financial difficulties which confront China to-day.

Secondly, to the student of railway economics, the study made by Mr. Shaw has presented an addition to the literature on China's railway problems which is constructive and original. Much of the material is the result of careful research carried on for a period of more than two years, and of a close association with the planning and construction of a railway of the type which is described. This has been done with a back-ground of forty years of experience in engineering work which includes his three years of service as technical adviser to the National Construction Commission of the National Government and the Chekiang Provincial Government. This monograph will have a high academic and technical value both in this country and abroad.

Last, but not least, the successful experiment of the Hangchow-Kiangshan Railway, made under the leadership of Mr. Chang Chin-kiang, the former Chairman of the Chekiang Provincial Government, with the strong backing of the banking groups of Shanghai and Hangchow, well illustrates both the advantages and the need of constructive statesmanship on the part of our National and Provincial leaders.

For these reasons, I take great pleasure in recommending Colonel Shaw's authoritative work to the readers of the *Chinese Economic Journal*, and particularly to those students of economics who are interested in China's current transportation problems.—KINN WEI SHAW.

Bank of China, Hangchow, June 16, 1932.

[*The following article has a direct relation to a preceding article by the same author on "The Hangchow-Kiangshan Railway," which appeared in the October, 1932, number of The Far Eastern Review.*]

THE object of this discussion is, first, to emphasize the urgent need of the Republic of China for a great increase in its railway mileage and, second, to suggest a plan for securing this increase at a lesser cost than would be required if all new lines were to be of the standard, heavy-duty type.

The construction of light railways is advocated to meet the immediate needs. Conditions are enumerated under which these lighter lines are warranted, together with suggested standards and a number of general principles.

Owing to the suggestions frequently made, that narrow-gauge lines would assist in meeting the present situation, considerable space is devoted to the discussion of special-gauge railways, attention being drawn to the insignificant saving in first cost, the effect of a narrow gauge on cost of operation, and the obstruction to traffic flow at points of connection with other lines, of a different gauge. To emphasize these points, reference is made to the disastrous results suffered by other countries, following the introduction of mixed gauges.

The effect of gauge on cost of line is illustrated by means of estimates covering two hypothetical railways, one of standard gauge and the other of one-meter gauge, but with the two lines identical in all other respects.

There is also included a comparative estimate of cost of roadway for light, intermediate, and standard railways; all built to the same standards as regards limiting curvature and grades, but with other standards varying to fit the character of service for which each type might be considered best suited. This is followed by a description of the more important elements entering into each estimate.

A discussion follows of the economic capacity-limit of goods cars, with a graph showing costs of cars of various capacity, ratio of pay load to dead load, and the cost of each type of car, per unit of capacity.

Several tables are included, giving the relative standing of various countries as regards railway mileage, examples of extreme curvature employed on standard-gauge lines and the cost of transporting goods and passengers by the various means which are in common use in this country.

The closing paragraphs are of a general nature, applying to the railway situation in China as a whole.

Introduction

In population, demands of society, and even in industrial development, China has advanced far beyond her transportation system; while for the quick movement of troops and munitions, which may be required at any time for protection against foreign foes, her facilities are woefully inadequate. The road systems constructed during previous generations have not been maintained; it is doubtful if the waterways are as efficient as they were in former years; and the construction of railways and modern-type highways has not kept pace with the growing needs of the country.

If anyone were inclined to doubt the need for more railways, he would be convinced by a survey of the situation in other countries the relative prosperity of which, it is generally conceded, is indicated to a considerable extent by the facilities provided (either by nature or by man) for internal and foreign commerce. As railways are by far the most important single factor of inland transportation, the degree in which they have been developed in each country may be taken as an indication of the material advancement of that country.

Some years ago, Mr. J. E. Baker, adviser to the Ministry of Railways, presented in his *Explaining China* a comparison of the railway facilities in various countries, illustrating his point by a table showing the number of miles of railways per 100,000 population. As the author pointed out, such a table can not be accepted as a true index of the relative adequacy of facilities as there are many factors which it does not take into account. For example, it is doubtful if Australia, with its 404 miles of railway per 100,000 people is as well served as are England, Scotland, Ireland and Wales, which have only 52 miles per 100,000. In this case, the additional factors consist of a more dense population, greater relative length of coast line, more internal waterways and a better developed highway system.

A somewhat better index, but still far from satisfactory, might be obtained by using the figures presented by Mr. Baker, by multiplying these by a "density factor" consisting of the population per square mile. Such a comparison is given in Table I, the first column of figures being taken from Mr. Baker's list; the second from the latest obtainable data on population and areas of countries; and the third is the product of the first two.

TABLE I.—*Railways of Various Countries.*

Country	*Miles of Ry. per 100,000 population*	*Population per square mile*	*Miles of Ry. times Density*
Australia	404	1.85	747
Canada	378	2.6	983
China (not incl. Mongolia or Thibet)	2	225	450
France	64	193	12,352
Germany	57	338	19,266
Great Britain	52	370	19,240
India	11	176	1,936
Italy	31	352	10,912
Japan	12	402	4,824
New Zealand	254	12.7	3,226
Russia	26	17.8	463
Siam	9	45	405
Spain	48	109	5,232
Switzerland	78	243	18,954
U.S.A. (Continental)	261	35	9,135

In spite of the rapid advance in efficiency of other methods, the railway still provides the most feasible, economical, and in every way the most satisfactory means for transporting overland, the bulk of the commerce of the country. Highways are suitable for freight haul over relatively short distances, and for passenger service for somewhat greater distances; aeroplanes, if speed is of greater importance than cost; canals and rivers for certain heavy commodities; and cart, pack animal, wheelbarrow or human porterage if no other system is available—but none of these can compare with the railway in general adaptability and suitability, for the movement of goods and passengers over considerable distances.

While the cost of transportation, without consideration of speed, convenience, protection, and comfort, will not always provide a true measure of suitability, the cost per unit-distance is the best single feature for comparing various means of transportation which may be under consideration. Table II, "Cost of Transportation in China," has been prepared for this purpose. Wide variations from the rates given, will be found, though those which are included in the table will give a fair comparison, under what may be assumed as average conditions. In general, the rates included are those which are common in sections of the country where each type of transportation is in general use. The cost of transportation by pack animals, however, is based on insufficient data and should be viewed with suspicion.

In most cases, the rates shown by Table II will provide only a bare living wage for the laborers, in the cruder forms of transportation (such as porterage and wheelbarrow haul), while those methods which require a large capital investment will provide better wages for the laborer and a fair return on the capital invested.

Not only should the character of service rendered be considered in making a comparison of possible alternate methods, but account is to be taken of the varying prices due to varying commodities and quantities. For instance, the most of the railway lines have adopted a six-division classification of freight, and also, there is a lower rate for carload shipments than for smaller lots. For the purpose of comparison, however, railway rates on large shipments of ordinary materials, shipped for considerable distances, are given.

For those types of transportation, such as rickshaw and sedan chairs, which provide but one class, the rate is shown in comparison with third class of the railways though in essential details, they do not even compare in comfort and convenience with the lowest class of railway service. In the matter of including personal baggage, they are especially deficient.

Only figures from Chinese sources have been used for, while volumes of data could be secured from other countries, especially of the cost of railway and motor truck haul, conditions are so different that a comparison from such figures would be of little interest.

TABLE II.—*Transportation Costs in China.*

Note that distances are stated in kilometers, weights in metric tons and rates in M$.

FREIGHT—Per Ton-kilometer

Type of Transport	*Ordinary Load*	*Limits Dist. per day*	*Rate per Ton-Kilom.*
LAND			
Railways	30	300	0.010
Auto trucks	1.5	150	0.100
Carts (animal drawn)	1.0	40	0.100
Wheelbarrows	.08	25	0.200
Pack animals (see text)	.08	40	0.300
Porterage (human)	.04	25	0.450
WATER			
Junks, upstream	—	40	0.022
„ interior canals	—	—	0.019
Yangtze river boats—Upper	—	—	0.116
„ „ „ Lower	—	—	0.020
Coasting steamers	—	—	0.024

PASSENGERS—Per Passenger-kilometer

Type of Transport	*Ordinary Distance per Day*	*Rate per Passenger-kilom., and Class First Class With Berth*	*First Class No Berth*	*2nd*	*3rd*
LAND					
Railways	700	.06	.045	.03	.015
Auto-bus	200	—	—	—	.020
Rickshaw	60	—	—	—	.060
Chair	40	—	—	—	.110
WATER					
Junks—Upstream	40	.020	—	.0125	.006
Yangtze river boats	300	.070	—	.050	—
Coasting steamers	400	.060	—	.035	—
AIR—Shanghai to Hankow (830 kilom. ÷)				.240	

Even in one section of this country, there frequently is a wide variation in costs for the same class of service. Wheelbarrow and porterage are especially affected by weather, road conditions, and the immediate supply and demand. Prices for carrying goods by coolies have been known to vary in a small section, from 25 cents to 70 cents per ton-kilometer, and the loads carried, from 30 to 80 kilograms. Over one route of 3½ kilometers, there is an established rate for carrying incense powder, from the small village where it is manufactured to the point of shipment by boat. The cargo for a strong man is 80 kilograms and the price paid for carrying is equivalent to 50 cents per ton-kilometer.

If we accept the figures of Table II as being fairly representative, the only reasonable substitutes for the railway are the motor-bus and trucks on good highways and boat service on canals and rivers where these are available. As each of these is able to render efficient service in the particular field for which it is suited, and as they are adaptable for some service for which the railway is unsuited they should be developed in a manner which will contribute most to the welfare of the country.

Considering present, and probable future needs, the rational procedure would appear to be the preparation of a comprehensive transportation plan for the entire country, with rail lines serving as the main arteries; highways to serve both as feeders to the railways and as independent radial units at important centers; with canals and rivers to be utilized in those sections where they are feasible and can be used to advantage.

In advancing this idea of a general transportation plan, no claim is made of originality. It is stated more for the purpose of emphasis. Government officials have repeatedly stressed its necessity and have done a considerable amount of constructive work in its direction.

By following such a plan, destructive competition will be avoided and the day will be hastened when every section of the country will have access to a modern means of transportation.

Type of Railways to be Built

Recognizing the two facts; that there is an urgent need for a great increase in facilities for interior transportation, to meet the demands for social, economic, and political progress; and that the construction of railways will most nearly meet these demands; there remain the most pertinent questions—"Where shall these railways be built?" and "What standards shall be adopted in their construction?"

It has been stated by men well informed regarding the local economic situation that; "Given a stable, well administered government, a railway could be constructed in almost any section of China and it would become a paying business from the start." The truth of this is well illustrated by the history of the Peiping-Hankow line which did not follow established lines of commerce and for which it was not claimed, even by its promoters, that it would become profitable for a number of years. And yet it proved to be a profitable investment almost immediately. With peaceful conditions prevailing in China, and freedom from outside interference, there is scarcely a railway in the country which can not be operated at a profit and, at the same time, contribute to the welfare of its patrons and of the section which it serves. If it were possible immediately to treble the mileage of railways of the country, and

then to continue construction at the rate of several thousand miles per year, the needs of the country would not be exceeded; but governing conditions dictate a more deliberate procedure. If from no other cause, the limited funds available for railway construction place an obligation on those in responsible charge to select those lines for early construction which will most nearly meet the present needs.

Not only does the limitation of funds affect the routes to be selected for early construction, but it should, in many cases, dictate the type of construction. The standards as promulgated by the Ministry of Railways are well suited to lines handling moderately heavy traffic and it is quite possible that the greatest ultimate economy could be secured by adhering to these plans for such lines as should be built during the next few years, if each line were to be built with the sole idea of an independent business investment. It is certain however that for many of the future lines, their territory could be well served by lighter, and correspondingly cheaper, construction, making it possible to build a greater mileage within a given limit of funds.

This discussion will deal principally with these lighter lines, present conditions indicating that they should be built in considerable numbers, and continued as light railways until such a time as capital (from outside sources or from earnings) may make it possible to revise them to higher standards.

For convenience, an arbitrary classification will be adopted, based on the weight of rail employed. This will consist of:—

Industrial and special lines—Rails of 30 lb. and less per yd.

Light railways—Rails of 35 to 45 lb. per yd.

Intermediate railways—Rails of 60 to 75 lb. per yd.

Standard railways—Rails of 85 lb. and over.

Also, only two gauges will be considered, a "narrow-gauge" of one meter and the "standard-gauge" of 4-ft. 8½-in. A representative example of light railway construction will be discussed in detail, this line being designed for 35 lb. rail and with track structures, rolling stock and other features consistent with the limits imposed by the rail. There may be conditions warranting the construction of a railway of still lighter material and design but these would be special and the problems could be of only local interest.

The reason for adopting the 35 lb. rail is that it is about the minimum section which can be employed satisfactorily in ordinary railway service if types of rolling stock and methods of operation similar to those employed on standard lines are to be used. Even with such rail, it will not be feasible to interchange rolling stock with standard railways freely, though all cars of moderate size can be handled in the terminal yards of the light railway, and the light cars can be handled on standard lines with little trouble.

There is another reason for the consideration of the 35 lb. rail, which will be important so long as it lasts. The combination of steel manufacturers maintains a minimum-standard price for all rails which are in common demand but rails which are not covered by this understanding (and this applies to 35 lb. sections and lighter) may be purchased on an unrestricted, competitive basis.

As a result of this free competition, quotations for 35 lb. rails recently have been made at a price not greatly exceeding 50 per cent of the cost per ton of the next heavier section. This condition may be only temporary but it is worthy of consideration.

While the 35 lb. section is suggested as the minimum, it definitely is not recommended for use on all lines for which only limited funds are available. Excepting for very light traffic, a heavier section is preferable, even if this should require a considerable sacrifice in such items as alinement, ballast and spacing of sleepers. The additional investment required for the heavier rail will (up to a reasonable limit) yield greater net returns on a line of moderate traffic, than will a similar amount invested for almost any other single item, excepting only drainage and reduction of controlling grades. The section of rail definitely limits both the axle loads and train speeds and each of these will be an important factor in fixing the ultimate capacity of the line. They will also have a marked effect on the efficiency of operation, long before this capacity has been reached.

In the later discussion of the light, intermediate and standard railways, it will be shown that the change from 35 lb. to 45 lb. rail will result on only a small increase in capital investment, provided that all other items remain the same.

Were it not for the fact that a light railway may be converted to a standard railway at a very small increase in ultimate cost, one would hesitate in recommending the expedient of the cheaper construction but, with conditions as they are, it seems that the wise course would be to adopt the lighter and intermediate standards for all new lines of the immediate future, excepting only those few which may almost certainly be required for heavy service during the first few years of operation.

Considering first, the objections to such a course, it is probable that, within the next few years after operation is started, demands of traffic will outgrow the capacity of the light railway; the cost of operation, after a medium traffic has been developed, will be greater than for a heavier line; and the required increase in efficiency and capacity can be secured only by providing heavier rails and rolling stock of greater capacity. There probably also will be required some strengthening of track structures.

As opposed to some of these objections, and tending to minimize others, it will be possible to build a line of given length for less money—or stated otherwise—a greater length of line can be built and a greater area served by a given investment; there will be a saving in interest on the investment which will more than offset the loss in operating efficiency until a heavy traffic has been developed; when re-construction becomes necessary, relieved rails may be profitably employed in the construction of branch lines and sidings; the original rolling stock will be suitable for use on branches, and on local trains of the main line; and if later revision is considered in the initial design and construction, the additional expense (over what they would have cost if originally built to standard), necessary for revising track structures, can be all but eliminated. This will be practically true of tunnels, particularly true with trestles and culverts, but probably not applicable to important truss bridges.

The Design of a Light Railway

General Principles.—In preparing plans for a cheaper type of construction, the prime objective should be to create an instrument for efficient transportation which will be consistent in design, and will yield the greatest possible returns, both in service and earnings; and to do all this at the lowest possible cost. So far as it can be done without defeating this main objective, the plans should include provisions for a later revision to higher standards. In many details, the cheaper line will simply be a scaling down in size of elements (though seldom in quality) from the standards found best suited for more important lines. This will be true of the weight of rail used; size and capacity of locomotives and cars; load capacity of all temporary track structures; and many other items.

A probable future revision to higher standards will influence the location of the line, the adjustment of grades and even the details of such structures as culverts, wooden trestles and masonry supports of important bridges. Even for a light railway, reasonably good alinement is important while heavy grades may be even more of an objection than on a line for which extra heavy and powerful locomotives may be provided for special conditions.

There are many expedients which may be adopted for reducing the initial outlay and which will not materially add to the ultimate cost of the revised and improved line. Frequently-broken grade lines, which would not be suitable for long trains, operating at high speeds, are not particularly objectionable for short, slow-speed trains, and by proper planning of the work, these can be corrected when required, without serious inconvenience to traffic. Culverts with long barrels, and practically no headwall, can be constructed as cheaply as shorter culverts with large headwalls. The former type lends itself well to later widening of embankments which may be necessary for a wider roadway standard or for grade reduction (which usually includes track raising and embankment widening in the valleys). Pile and timber-frame trestles can be constructed (at no greater cost) to permit the later addition of an extra pile or post, and an additional pair of stringers, and this revision can be made without interruption to traffic.

In some cases, the additional expense necessary for the later revision should be included in the initial construction. This certainly is true of tunnels, which can be made suitable for any class of service at only a slight increase over minimum requirements while a later enlargement, with consequent interference with traffic, would be a serious and expensive procedure.

Long-span bridges will present a special problem, each of which should be judged on its own merits. There is no known method by which such a bridge, designed for light loads, may be re-modeled economically, to fit it for heavy loads. For this reason, the initial structure should be built for the heavier loading if it appears reasonably certain that such service will be required in the near future, a lighter structure being provided if an early increase in loading appears to be improbable. In any event, the masonry supports should be suitable for the heavy construction as this will add little to the initial cost and can not be provided later without great expense.

Excepting as already indicated, the general principles of location, alinement, grade adjustment and similar features remain true for all railways, from those handling the lightest to the heaviest traffic. These have all been so thoroughly covered, in works which are available to all, that a discussion at this time could be of little value. Many books and papers have been written on the subject but in scope, and a thorough consideration of all phases, none of them approaches the monumental work by the late Arthur M. Wellington—*The Economic Theory of the Location of Railways*. Some of the data presented are now obsolete, on account of the advances made in the last few years, but the principles of economics, which he has set down are as true to-day as when first written.

ALINEMENT AND GRADES.—Mention already has been made of the use of broken grade lines as a means of reducing first cost. With traffic of only moderate density, it frequently is possible to raise sags and widen embankments by train service, at a lower cost per unit of material placed, than was possible in the original construction. This is especially liable to be the case if long hauls are involved. By the use of a work train, material excavated in widening cuts may be hauled for several miles and utilized for embankment widening and raising.

While a revision of grade may be a comparatively easy and inexpensive operation, resulting in a minimum of wasted material and labor, a revision of alinement is a far different matter as it entails the complete abandonment of all earthwork and the most of the track structures. A wholesale waste of this nature should be avoided, even if it is necessary to hold the first cost to the lowest possible limit. If a particular section demands the use of excessive curvature which would not be permissible on a higher-type railway, it usually will be possible to limit the length of such objectionable sections in a manner to reduce so far as possible, the amount of line which later may be abandoned. In the case of a single very sharp curve, skirting a bluff, the approaching tangents should be placed to permit later improvement by making a widened cut in the bluff, or a tunnel, if this is the apparent best method of improving the line. The change can then be made with a minimum of disturbance to the line and at much less expense than would result if the future revision was not planned in the original construction.

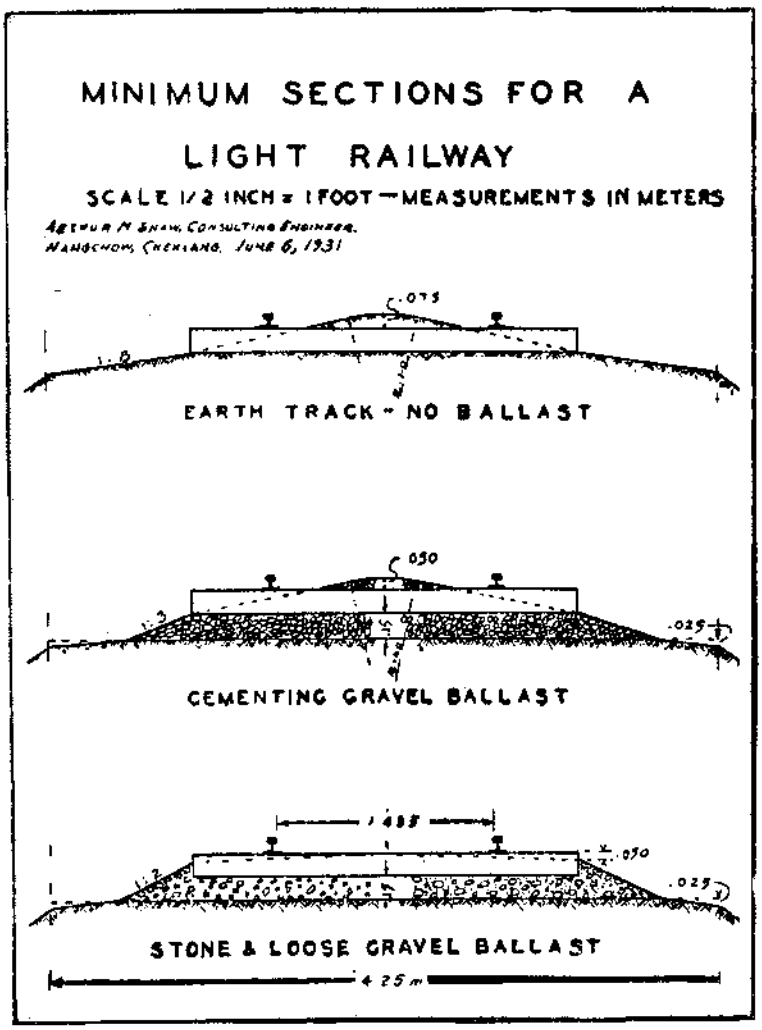
Engineers frequently incur more expense than is warranted, in an effort to secure extra long tangents and light curvature. Excepting on lines operating fast passenger trains, the expenditure of large sums to avoid curvature is seldom justified by the savings effected in operating costs.

ROADWAY SECTIONS.—The width of roadway to be adopted will depend on so many factors that a single standard can not be devised which will be best suited to all conditions though it is obvious that the width found best suited for important, heavy-duty lines would be unnecessarily expensive for a light railway. Under average conditions, and assuming that the railway will be ballasted for a depth of six inches under the sleepers, a minimum width of 4.40 meters on embankments, and between the side ditches of cuts should be provided. This should be increased at bridge ends and other important points. A general increase to a minimum width of five meters should be one of the first forward steps to be taken when funds for improvements are available.

BALLAST.—In this item, a substantial saving from standard practice may be made without any considerable sacrifice in riding qualities of the road, safety, operating costs, or cost of maintenance. The moderate axle loads employed and the low speeds of the light railway do not demand the depth of ballast required for heavier service. Several of the important trunk lines of the U.S. use twelve inches of sub-ballast, with another twelve inches above this and under the bottoms of ties; or a total depth of ballast (including that between the sleepers) of over 2½ feet.

For a light railway, at least for the initial period of operation, six inches of ballast under the sleepers should be sufficient. This will require from 700 to 800 cubic meters per kilometer of track, depending on the section adopted.

Not only can a saving in quantity of ballast be made, but the quality (hence the price) may be somewhat below that usually specified for more important railways. For the first application, gravel of an inferior quality, or even sand, may be employed though



care should be exercised in the selection of materials used as sub-ballast. Coarse, cementing gravel (containing a considerable proportion of clay) frequently is used successfully as top-ballast but such material has no place as a sub-foundation for track, the clay content making it impossible to provide the drainage which is possible when used as an upper layer, and which is essential to its successful use.

Many first class roads advocate the use of a fine material as sub-ballast, using anything that is readily available, such as engine-house cinders, quarry screenings or sand. Expensive crushed rock, applied directly to a new roadbed, will nearly all be lost by sinking into, and mixing with, the earth, while the finer materials appear to mix with the top portions of the embankment to a lesser degree.

Where the soil is more or less sandy, it may be practicable to operate for a few years without ballast, or with ballast only in cuts and at other special points. Until about forty years ago, it was common practice in the U.S.A. to construct new lines with no provision for ballast. As they became available, cinders were used at the points giving the greatest amount of trouble and, as traffic increased, gravel pits were opened and the track was gradually ballasted. Broken stone later came into general use, though there are still many miles of important lines which are ballasted with gravel.

If good gravel is obtainable, at a price materially below that of broken stone, the former should be used on all lines which have only a light, or moderate, traffic. The section adopted should be varied to suit the class of material employed; following closely the accepted standards for rock ballast if the gravel is "loose"

and free from clay, and more nearly approaching the section suggested below for earth track, if a cementing gravel is used.

If advisable (or necessary) to operate for a considerable length of time without ballast, a special track section should be adopted which will insure the best possible drainage of the roadbed. Excepting in very sandy soils, this section should be practically a reversal of that which is generally considered suitable for rock ballast. For example, it has been found necessary to avoid heavy tamping at the center of rock ballasted track, to avoid "center-bound" track, while with earth ballast, there is no danger from this source. On the contrary, the entire space between the rails should be well tamped, the center crowned to a level with the tops of the rails, and the sides sloped down to the bottoms of the sleepers at their ends. The accompanying suggested standards show the section of "Earth Track" which was generally found most suitable in the U.S.A.

While the reasons for initial operation without ballast are usually financial in their nature, there are certain economic advantages to be gained, other than a postponement of capital investment. A year or more of compacting of the sub-grade under traffic makes it possible to secure a better and more permanent foundation than is possible if ballast is applied at the time that traffic is first started. Many railways have found that if ballast is deposited on a new embankment, much of it is lost by sinking into, and becoming mixed with, the earth sub-grade, not only resulting in a loss of the material but also creating an undesirable pocket for the collection of moisture.

When it was undertaken to rush through the construction of the railways which were built after the American occupation of the Philippines, it was found that while the plans called for only 1,500 cubic yards of ballast per mile, nearly 4,000 cubic yards were placed in securing an effective depth of six inches under the sleepers, practically all the excess having disappeared into the sub-grade.

One extreme case which came under the writer's observation, included raising of the track to a height of several feet for the purpose of reducing a grade. The raising was done on gravel while the sides were built up from earth taken from adjacent borrow pits, this borrowed material being a tenacious clay. Trouble did not begin for several years after the work had been completed but it finally became so serious that it was necessary to build a temporary trestle for carrying traffic, excavate the faulty material by steam-shovel, and replace it by suitable material hauled in by train. The central reservoir, formed by the core of gravel, had gradually saturated the clay of the sides so that slides occurred frequently, making it impossible to maintain a dependable schedule over this section.

That the troubles described above were not primarily due to faulty material is shown by the fact that the original embankment, which had been in service for over thirty years, had been constructed from clay from the same pits and had never caused any serious trouble.

Gauge of Railways

Although this country has constructed but a fraction of the railways necessary for its immediate requirements, it may be taken for granted that the standard gauge which, with few exceptions, has been adopted throughout the Republic, will be adhered to in all future lines that are planned to form links in the general system of the future. A still wider gauge might prove economical for exceptionally heavy service, but development already has progressed too far for a change in that direction, even though it might appear to be desirable.

For light railways, a narrower gauge of 2½-ft., 3-ft., or one meter frequently is suggested while the *Ko-Pi-Lin-Ping* Railway in Yunnan Province is of 2-ft. gauge. These narrow-gauge lines offer some undoubted advantages under certain conditions, but the objections to their use are so many, and of so serious a nature, they should never be considered excepting for the few rare cases in which the advantages to be gained are substantial and certain and where the objections may be reduced to the minimum.

To give force to the above statement, the various claims which are advanced by the advocates of narrow-gauge lines are first listed and then discussed in detail, as follows:—

Claimed Advantages of Narrow-Gauge Lines

(*a*) They can be operated with safety and economy around sharper curves than are permissible for standard-gauge lines, hence effecting a saving in grading, especially in mountainous country.
(*b*) Lighter track, track structures, and equipment may be employed, greatly reducing the cost.
(*c*) Operating costs will be less, due principally to the lighter-weight rolling stock.

Before entering into a discussion of these claimed advantages, it might first be well to consider the effect of mixed gauges on the transportation system of the country as a whole.

It is obvious that, other things being equal, it would result in a great economic waste to construct any line to a special gauge if that line may later be in a position to serve as a link of a general system, or even to serve as an important feeder to such a system. When such a stage of development has been reached, the special-gauge line will be faced with two alternatives, neither of which is attractive to operating officials or investors. One possibility will be to transfer all goods and passengers at junction points while the other will be to reconstruct the line to standard gauge.

The extra tax on the revenues of the line, if the former method is followed, might easily result in a net loss in operation; and the cost of the latter, involving the reconstruction of all track and track structures, and scrapping of all rolling stock, would be staggering if not prohibitive.

With the possible exception of a few short lines, built exclusively for special industrial purposes, and perhaps excepting a railway system for the Island of Hainan, there is scarcely a railway in operation or contemplated, in this country which should not eventually become an interconnected part of a general rail transportation system, and which should not be constructed in a manner which will fit it for such service at the least cost for revisions and adjustments.

The history of railways in other countries is replete with illustrations of the folly of permitting varying gauges. The last special-gauge line of any importance in the U.S.A., the Denver & Rio Grande Railway, was able to maintain its unique position for many years, owing to its isolated location and the conditions which made it possible to charge the exceptionally high rates that are noted later. In spite of these unique advantages, the need for quick and economical transfers at junction points; coupled with the necessity for more economical transportation, caused by gradually encroaching competitive lines, forced even this railway, with its several thousand miles of track, to change to standard gauge. The entire system was reconstructed, with the exception of a few, unimportant branch lines, and the most of the rolling stock disposed of for practically the price of scrap.

Limitations of Alinement.—As will be more fully shown in a following section, any comparison that is to be of value must be made comparable as to details. For this reason, in considering the matter of alinement, we should compare narrow-gauge equipment and operation, not with those of a heavy-traffic main line, but with a light railway of standard gauge, equipped with cars and motive power, and operating at speeds that are identical with those of the narrow-gauge line.

While it is true that a narrow-gauge train can pass around a curve which would be too sharp for the normal operation of standard-gauge equipment, the limits of permissible curvature for the latter are not nearly so restricted as is commonly supposed. The following list of small-radius curves in actual use up to recent times on important, standard-gauge railways, is given to illustrate the feasibility of sharp curves for meeting special conditions. This list was taken partly from "Location of Railways" already mentioned and partly from the writer's own experience:—

Table III.—Examples of Sharp Curves on Standard-Gauge Railways

Name of Railway	*Location*	*Radius in Meters*	*Remarks*
N. Y., N. H. & H.	Springfield, Mass.	125	Main Line
Baltimore & Ohio	Harper's Ferry	122	" "
" "	" "	92	" "
" "		43	"Y" track used only by "consolidation" locomotives.
Illinois Central	Louisville, Ky.	73	Main Line
Virginia Central	Rockfield Gap	72	" "
Pennsylvania	Pittsburgh	67	" "

A personal observation of the operation of regular trains over a half of the curves given in the above list, and a second-hand knowledge of all the others, indicates that in no instance has there been any serious operating difficulty encountered on any of them. The writer was in charge of track maintenance on the Louisville Division of the Illinois Central, which included the 24 deg. curve mentioned, and can recall but one derailment on this curve, this being caused by a defective wheel flange. Several passenger trains passed over this curve daily, each consisting of an "Atlantic" type of engine, standard day coaches and several Pullmen cars.

In converting the Denver & Rio Grande Railway to standard gauge, several of the 24 deg. and 30 deg. curves (73 and 59 m. radii) were continued in use.

Certainly on a curve of 80 m. radius, and probably on one of 70 m. radius, properly constructed, standard-gauge rolling stock can be operated at fully as high a speed, with an equal degree of safety, as is possible with a narrow-gauge line. On curves of longer radii, the factor of safety at equal speeds becomes increasingly favorable to the wider-gauge line.

COMPARATIVE COSTS OF ROADWAY AND EQUIPMENT.—The idea that a narrow-gauge railway is materially cheaper in first cost is so generally accepted that considerable space will be devoted to a discussion of this point.

As usually built, there can be no doubt that the popular impression is correct, but its truth depends mainly on the fact that narrow-gauge lines usually are of low capacity, built for only moderate speeds, and frequently they are of the most flimsy construction. The only way in which a true comparison can be made is to assume a railway of each gauge, these being designed to render identical service; for a railway is of value only on account of the service which it renders, and the amount and character of this service form a true gauge of its value.

From the nature of their design, narrow-gauge railways are limited in the size of transportation units, and in train speeds. For this reason, a standard-gauge line is assumed for comparison which will fall well within the limits commonly considered suitable for narrow-gauge operation.

In order that the subject may be treated in a concrete way, a hypothetical railway of each gauge has been planned, these two lines each being 150 kilometers in length and built through a reasonably easy country, with no tunnels, major stream crossings or other exceptional features, but under conditions which easily may be paralleled in many sections of China. Following are the elements assumed for each line:—

50 Freight cars, each of 12 tons capacity.
12 Coaches, capacity of 50 passengers each.
6 Locomotives, 54 tons each.
35 lb. rails.
Sleepers to afford 2½ sq. ft. of supporting area per lineal foot of track.
Depth of ballast (from top of sleepers), 12 inches.

An estimate of the cost of each of these lines is given in the following table.

TABLE IV.—COMPARISONS OF COSTS OF STANDARD-GAUGE AND NARROW-GAUGE LIGHT RAILWAYS

No.	Description	Standard Gauge	Narrow Gauge	Difference
1	Sleepers	264,000	264,000	—
2	Ballast	307,500	270,600	36,900
3	Grading	1,116,400	1,068,400	48,000
4	Concrete Culverts	222,250	216,590	5,660
5	Timber Bridges	500,000	500,000	-
6	Tracks (exclv. of sleepers)	1,256,200	1,256,200	..
7	Shops, Water Sta's and Bldgs.	100,000	100,000	.
8	Track Tools and Misel. Equip.	15,000	15,000	—
9	Rolling Stock	984,000	984,000	....
10	20% for right of way and misel.	953,000	953,000	
	Total (150 kilom.)	$5,718,350	5,627,790	90,560
	Per kilometer	38,122	37,485	637

$$\frac{90,560}{5,718,350} = 1.58\%$$

The various items of these estimates are given as follows:

1.—*Sleepers.*—These are given first both for the reason that they are frequently mentioned as constituting one of the major items of saving by use of the narrow gauge, and because the length of sleepers used may determine, to a certain degree, the dimensions of ballast and roadway sections, and lengths of culverts.

The two principal functions of track sleepers are:
(*a*) To hold the two rails to proper gauge.
(*b*) To serve as a spread foundation for the rails.

It is in connection with this latter feature that by far the largest amounts are spent for roadway maintenance and hence, it is of major importance to operating officials and, as affecting net revenues, to investors.

For the present purpose, we may assume that the supporting power of this spread footing is in direct proportion to the supporting area. Under this assumption, it is obvious that for the identical service contemplated, the supporting area for the narrow-gauge line should be the same as for the standard-gauge line.

Besides serving as a spread footing, sleepers must have sufficient thickness to permit their acting as a beam and to hold the track spikes. This latter requirement demands a thickness of not less than five inches.

Basing the track design on a minimum of 2½ sq. ft. of supporting area per lineal foot of track, the economical dimensions for sleepers probably would be 5-in. × 7-in. × 8-ft. for the standard gauge track and 5-in. × 8-in. × 7-ft. for the narrow gauge. In each case, the sleepers would be placed on 2-ft. centers and would contain the same amount of material per lineal unit of track, and the cost per unit of length of track will be the same.

To reduce complications in the estimate, it is assumed that the same type of sleepers will be used throughout the line, over bridges as well as on embankments and, for this reason, they will not enter into the comparative estimate of bridges.

2.—*Ballast.*—The estimates of this item are based on the assumption that a suitable supply of gravel may be procured at some point convenient to the line, and that a section of ballast will be adopted which is equivalent to that indicated by Fig. I for "Loose Gravel Ballast." For the standard-gauge line, the theoretical section calls for 656 cubic meters of ballast per kilometer of track though, in actual practice, from 20 per cent to 30 per cent more will be required, the exact amount depending on the condition of the sub-grade. The estimate was based on a cost of $2.50 per cu. m. of ballast in place, with a 25 per cent increase in quantity over the theoretical section.

On the narrow-gauge line, the use of sleepers of shorter length will permit an estimated saving of 12 per cent of the ballast, or an estimated total saving on the 150 kilom. line of $36,900.00.

Even if the sleepers were reduced to seven inches in width and six feet in length (dimensions frequently employed on narrow-gauge lines) and a corresponding reduction made in ballast section, roadway embankments and culverts, the total saving, as compared with the standard gauge, would amount to less than $1,500.00 per kilometer, and this reduction would result in a great sacrifice of stability, with a substantial increase in cost of maintenance and operation. The resulting railway would, in no way, be comparable with the standard-gauge line specified.

3.—*Grading.*—While a 14-ft. (4.25 m.) roadway is indicated by the accompanying Fig. I as the minimum, it is assumed, that the lines contemplated by the foregoing estimates, built through an easy country, would be justified in adopting a somewhat greater width. The estimates are based on a roadway width of sixteen feet for the standard-gauge line and of one foot less for the narrow gauge, this reduction in width of roadway corresponding to the reduced dimensions of sleepers and ballast section.

In estimating the grading for these two hypothetical lines, it was assumed that there would be a total of 60 kilometers of cuts and 90 kilometers of embankment, about three-fifths of the excavation (not including side-borrow material) being rock. The total cost of all grading for the standard-gauge line was estimated to be $1,116,400.00 and the saving effected by the one foot reduction in width of cuts and fills, to be 4.3 per cent, or a net saving in this item on the entire line of $48,000.00.

4.—*Timber Bridges.*—In spite of the high cost of structural timbers, and their short life, there are many stream and canal crossings in this country for which a timber structure is a practical necessity. For such of these as may be found necessary, it is estimated that $500,000.00 will be required. As the volume, and nature of traffic; axle loads and train speeds will be the same on the two lines, regardless of gauge, the design of the timber bridges will be practically the same and the costs will be identical.

5.—*Concrete Culverts.*—In many sections of the country, materials other than concrete can be used to advantage in the

construction of culverts but for the purpose of easy comparison, none but concrete culverts were included in the estimates. For openings up to 12 sq. ft. section, concrete pipes were provided and for larger openings, six feet arch culverts were included. For openings greater than that afforded by twin culverts of six feet span, timber bridges were provided.

All culverts were planned to be constructed with extra-long barrels, with headwalls of negligible size, as before suggested. Disregarding the cost of headwalls, the cost of such culverts will be approximately in proportion to their length, and this was assumed in computing the saving effected by use of the narrow gauge.

6.—*Tracks.*—As the labor and material will be identical for the two gauges, there will be no difference in this item.

7.—*Repair Shops, Water Stations and Other Buildings.*—It is possible that an insignificant saving might be made in the size of the engine house but, with this possible exception, the cost of all items under this heading will be unaffected by the gauge.

8.—*Track Tools and Miscellaneous Equipment.*—These will be affected in no material way by a change in gauge. There will be a slight difference in the construction of trolley cars but, for cars of equal capacity, manufacturers quote the same price, regardless of gauge.

9.—*Rolling Stock.*—This item makes a particularly strong appeal to the average, non-technical man. He usually takes it for granted that a narrow-gauge car or locomotive is comparatively inexpensive. On account of this popular impression, it might be well to repeat; the foregoing estimates are based on two lines which are as nearly identical in all details as possible, considering the difference in gauge. As will be shown later however, complete equality can not be attained, on account of certain unsurmountable limitations of the narrow-gauge railway.

With this equality of service in mind, it is obvious that the locomotives and cars for a light railway which is to render a given service, should be of the same capacity, regardless of the gauge of the line. This uniformity of capacity will be assumed throughout, though in some cases of actual practice, this might present some difficulties. For instance, there has been no logical design prepared for a fifty-passenger car for use on a narrow-gauge railway though this is an economical and common size for light railways of standard gauge. The usual alternative for the narrow-gauge line is to build cars for a smaller number of passengers, thus increasing the cost per passenger-unit of capacity.

With special reference to locomotives, letters were sent to a number of manufacturers, inquiring particularly regarding the comparative cost of standard-gauge and narrow-gauge equipment. Uniform specifications, quite in detail, were furnished to each manufacturer, they were limited to sizes commonly employed on narrow-gauge railways and provided that, so far as practicable, the engines quoted should be the same for either gauge.

Various replies to these inquiries were received but from none of them was it found that either locomotives or cars could be purchased cheaper if narrow-gauge equipment were specified, while some stated that this would increase the price from five to fifteen per cent. The unit sizes specified were approximately the same as those included in the above estimates.

One manufacturer states: "Our experience indicates that for engines of similar weight, dimensions and pattern, differing only in gauge, there is no appreciable difference in cost. What extra expense is involved in the greater cross-measurements, is quite compensated for by the reduced length, as the greater distance between frames permits of widening and shortening the fire-box, with a corresponding reduction of length of frame and wheel-base."

Another manufacturer replied that the difference in gauge presented special difficulties in the construction of a well proportioned fire-box. Necessary modifications in fire-box and engine framing made it necessary for his company to charge a higher price for a narrow-gauge locomotive than would be quoted for one of equal capacity but of standard gauge.

Concerns making a specialty of freight cars advise that the saving in width of trucks of narrow-gauge cars is offset by the additional length required or, if the length of body remains the same and height increased to secure the required capacity, the cost is materially increased. If the body-dimensions of cars follow closely those of standard-gauge practice, large orders will be accepted at practically the same price, regardless of gauge, but if special body-construction is required, or if the order is comparatively small, the cost of narrow-gauge cars will be the greater.

From the foregoing, it is apparent that, if there is any difference in cost of rolling stock, it will be in favor of the standard gauge.

Cost of Operation.—Many experiments have been made to determine the frictional resistance to train movement as affected by the radius of curves, gauge of track, length of wheel-base, and type of trucks. From these, it has been deduced that:

(*a*) Other conditions remaining the same, the effect of narrowing the gauge is small. One experiment showed an advantage of 4 per cent in favor of the narrow gauge in operating on a curve of 100 m. radius, at a speed of 27 kilm. per hour. The advantage was greater at lower speeds and less at higher speeds. On straight track, in good condition, there is no appreciable difference.

(*b*) Other conditions remaining the same, decreasing the length of wheel-base materially decreases curve resistance. No exact method has been devised for computing this gain but the recorded experiments would indicate that it is approximately in proportion to the reduction in length of wheel-base. To apply this practically, we may assume a standard-gauge goods car of 12 ton capacity, with a 22-ft. wheel-base; and a narrow-gauge car of the same capacity but with a 30-ft. wheel-base.

From the foregoing, we may deduce that on a curve of 100 m. radius, the narrow gauge might produce a saving of 4 per cent of tractive effort required but, due to the necessary increase in length of wheel-base, this would call for 36 per cent additional power, or a net loss through the use of the narrow-gauge cars of 32 per cent.

To serve as a summary of the foregoing discussion of narrow-gauge lines, the following is quoted from the book on railway location by Wellington, already referred to:

> "Whatever conclusion may be reached as to the proper standard of curvature for lines of fair traffic, it is certain that for a road to which the last degree of economy is essential, the intelligent use of sharp curvature offers one of the simplest, most effective, and most expedient methods of economizing in first cost."
>
> "A further advantage of so economizing is that at many points, the works may assume a mere temporary character for present necessities while being adapted for ready improvement in the future."

Table V.—Comparative Cost per Kilometer of Roadway and Structures of Various Classes

Classes as Represented by Rail Sections

Pounds per Yard		35	45	60	75	85
Kgs. per Meter		17.36	22.32	29.76	37.20	42.16
Rail and Fastenings Tons per Kilometer		37.49	48.43	64.66	80.38	90.92

Cost per Kilometer by Items

1	Sleepers	$1,760	2,320	12,300	15,400	15,400
2	Ballast	2,050	2,050	2,600	3,173	3,900
3	Grading	7,442	7,442	8,100	8,700	9,325
4	Timber Bridges	3,333	3,333	3.650	3,980	4.200
5	Concrete Culverts	1,482	1.482	1,600	1,720	1,800
6	Track (excl. sleepers)	8,375	10,800	14.420	17,900	22,500
	Totals per Kilometer	$24,442	27,427	42.670	50,873	57,125
Per cent of 35 lb. rail		100	112	175	208	233
Per cent of 85 lb. rail		43	48	75	89	100

Note that the cost of materials of foreign origin was estimated on the basis of M$4½=G.$1.00.

> "The belief in the narrow-gauge as an expedient and defensible system of construction, which was from the beginning chiefly founded on illusion and delusion, is rapidly passing away and all but gone."
>
> "As respects rolling-stock, there can not be a question that there is absolutely no practical advantage in the narrow gauge. Any reputable locomotive builder will contract to build engines of the same weight and power for either gauge, which will traverse the same curves, for the same price. The standard-gauge engine, in fact, will, or can, have enough shorter wheel-base, because of its greater width, to make it take curves a little better. The same is essentially true of cars."
>
> "The bridges and trestles are, of course, not affected by the width of gauge, if rolling stock of the same width and weight are to pass over them."

"The earthwork and masonry are affected only by whatever difference there may be in the width of the road-bed, which can not properly be more than the difference in the width of gauge. The ties may be only about three-quarters the usual length, but only at the expense of decreasing the stability of the track and increasing the labor required."

"There remains therefore, as the net gain from the narrower gauge, only the slight saving in grading and ties, which may amount to one to four per cent of the total cost of the line."

The author also emphasizes the fact that "the cost of maintaining track to a given standard of excellence is greater" and "the maintenance of rolling-stock is decidedly more costly."

In writing of the Denver & Rio Grande Railway (which then was still operating as a narrow-gauge railway but since has been changed to standard-gauge) the author states:

"The success of this line had little or nothing to do with gauge, but was due rather to the fact that it was cheaply built, and was assured a monopoly of a remunerative and growing traffic at very high rates—rates from three to eight times higher than were usual on lines farther east. Its narrow-gauge system was complete in itself, and connected with standard-gauge lines at but few points."

It was only a few years after the above was written, that all of the main line and the more important branches of the Denver & Rio Grande were changed to standard gauge. The high cost of transfer at junction points, and the sharp competition of newly constructed, standard-gauge lines, with their lower operating costs, were the principal causes of this revision of gauge. The bulk of the passenger business, between competitive points, was taken over by the new lines as the passengers preferred the better riding qualities of the wider cars.

From the foregoing data and estimates, and in the light of experience in other countries, there does not appear to be a single argument, that is worthy of consideration, for the further introduction of mixed railway gauges into that country. The transportation problems to be faced by the next generation will be sufficiently difficult without the addition of this wholly unnecessary burden.

Intermediate Standards

As already explained, the 35 lb. rail was assumed as being about the minimum section which may be considered for operation under conditions demanding ordinary, commercial service. There will be many occasions however, for the consideration of standards which are intermediate between this and the 85 lb. section now in general use on the main lines of the country. An attempt will be made in the following to work out a rational comparison of costs of a number of such intermediate lines, using as a basis of estimates for all, the same 150 kilometer line already described, but modifying the various details in harmony with each standard. To illustrate the method of modification followed; a 60 lb. rail could be placed on the same sleepers, using the same ballast, road-bed and structures contemplated for the 35 lb. rail, but it would be more logical to assume that if 60 lb. rails are provided, there will be a corresponding elevation of standards in other directions, in order that a consistent design may result.

As a convenient "label" for each type or class of line included in the estimates, the weight of rail (in pounds per yard) will be used.

In estimating the costs of the heavier standards, as represented by the 45, 60, 75 and 85 lb. rails, the total cost of track and switches in place will be assumed as being proportional to the weight of rails and fastenings. This introduces an error but it is so slight that it may be disregarded in an estimate prepared only for the purpose of comparison.

The accompanying Table V gives a comparative estimate of cost of five standards, including the 35 lb. standard already described and the four heavier standards above-mentioned. It will be noted that the transition in costs, from one standard to the next, will not plat on a smooth curve. This is due to the radical changes made in some of the items, in shifting from one standard to the next. The reason for this will be seen from the following explanation of methods followed.

1. *Sleepers.*—For the two lighter sections, it was assumed that sleepers from native timber would be used. With the exception of the greater thickness of sleepers (made necessary by the longer track-spikes required) the same standards were maintained for the 35 lb. and the 45 lb. rails. This is done for the reason that neither of these lines would be in a position to accept freely, all rolling stock which might be offered by connecting lines. The light-weight rail would necessitate limiting axle loads and only the lighter cars of the other lines could be handled over the main lines.

For all lines but those of the lightest, on which the initial cost must be kept to the lowest possible limit, there can be no doubt that the higher cost of sleepers which will insure a long service, is well justified. Native timber is contemplated for the 35 lb. and 45 lb. standards as it is assumed that these very light rail sections would not be chosen unless under the most stringent financial limitations.

The sleepers provided for the 60 lb. rail will be suitable for use with the heavier standards, though as renewals are required, sleepers of greater section may be substituted.

For the immediate future, there appear to be but two courses open for securing sleepers which will give a long life in Chinese railways; either the selection of timber (probably imported) which will resist decay and be otherwise suitable, or to import sleepers which have been given a preservative treatment. It is possible that conditions may warrant the use of steel sleepers though it does not appear that past experience will justify their general use in this country until further improvements in their design and manufacture have been made.

In spite of this increase in cost of special timbers or treated sleepers, there can be no doubt that they will effect an ultimate saving over the use of short-life, untreated material.

At the earliest possible date, provision should be made for the preservative treatment of sleepers and general construction timbers in this country. Even for those sections not supplied with any native timber it would be an economy to use imported pine, treating this with creosote or other preservative, after arrival in this country. It is possible that the plants at Pukow and Hankow could be rehabilitated for this purpose though they would be entirely inadequate in capacity under a normal program of construction.

Pine that is suitable for track sleepers can be grown in this country in comparatively few years and there should be an extensive planting of suitable varieties on unused hillsides. Within one generation, this country should be able to supply its entire requirements for such timber, without encroaching on agricultural lands.

2. *Ballast.*—Starting with the 45 lb. standard (which is to be the same as the 35 lb.), a proportional increase in ballast was assumed, up to the standard adopted by the Ministry of Railways for main lines. For each type, it was assumed that a 25 per cent increase over theoretical quantities would be required to provide for waste, and for loss of ballast in the sub-grade.

3. *Grading.*—As with the ballast, it was assumed that the 85 lb. standard would conform to the sections as adopted by the Ministry of Railways. In addition to the increased width of roadway, provision was made for a reasonable improvement of the grade line. The alinement was not to be disturbed but short sags in the grade line would be taken out to permit the operation of fast and important trains.

4. *Timber Bridges.*—The same general type of structure was carried through the series, but provision was made for more piles per bent and for more stringers, to care for the increasing loads. Estimates for all these bridges were based on the use of untreated, imported pine timbers and piles, the idea being that in all cases, these would be considered as temporary structures, to be replaced by steel or masonry. It is probable however that in many cases, the use of treated timbers for such structures would be warranted. Also, in some localities, permanent masonry structures can be built at a lower first cost than that of a suitable timber structure.

5. *Concrete Culverts.*—In accordance with the method previously suggested, culverts for the narrower road-beds were planned with long barrels and practically no head-walls, an extension of the barrel, or addition of head-walls, being provided to meet the requirements of the higher-class lines. It was contemplated that there would be some additional culvert expense as the result of raising sags in the grade line.

6. *Track Work.*—It is the section of the rail, more than any other one item, which limits the service to be given by a railway, but in order that the investment may be well balanced, the increase in the standard of excellence of any one item should be accompanied by that of others. As already noted, however, an exception was made in the transition from the 35 lb. to the 45 lb. standard. Incidentally, this affords an excellent opportunity for comparing the effect on total cost, of increasing the section of rail, with only minor

changes in other items. Thus we find that a ten-pound increase in rail weight adds to the cost only $3,000 per kilometer, including the increased cost of the thicker sleepers. To secure a measure of the advantage gained by this heavier rail, an average of permissible axle loads (as given by manufacturers of twelve different locomotives) was taken. This shows that an increase of axle loading of 27 per cent may be secured by this 12 per cent increase in investment for roadway.

For the very lightest traffic lines, the above point could be of only academic interest, but as the traffic increases to a point where train capacity is limited by axle loads and motive power, it will become of increasing importance on account of its effect on operating costs.

The cost of double-tracking frequently can be avoided, or postponed, by the use of heavier rail which will permit the use of more powerful locomotives, with longer and heavier trains.

The foregoing discussion should not be understood as a recommendation of the various items, as described, for each standard, regardless of circumstances; or even that they represent the most economical arrangement for average conditions. The material has been assembled more for the purpose of comparison, and to illustrate the effect on initial cost, of various modifications. It is easy to imagine conditions, for example, under which the interest of economy would be served by the use of road-bed and all other accessories conforming to the 45 lb. standard excepting that 60 lb. would be used. Such a course would be dictated clearly by the following combination of conditions:

(*a*) A fairly serviceable local supply of timber, available for sleepers.
(*b*) Imported sleepers difficult to secure and extra-expensive.
(*c*) Prospects for an early development of traffic to a point which would overtax the lighter rail.
(*d*) Capital obtainable to cover the additional cost, amounting to approximately $3,500 per kilometer.

On account of the wide variety of demands of the heavier lines in such items as shops, water stations, station buildings, rolling stock and miscellaneous equipment, these have all been omitted as being of little interest in making a comparison of cost. With the exception of rolling stock, these items will be affected as much by other factors as by the character and cost of roadway. There are a few general principles regarding some of these items, however, which have become well established and which are mentioned in the following.

Repair Shops.—A serious mistake frequently is made by building railway repair shops of too permanent a nature. It is a good plan, especially for a new project, to design these, including the engine house, of the cheapest practicable construction, consistent with efficient operation and full protection. One high railway official has recommended that engine houses be built with concrete walls only up to the height of the windows, with timber construction above, each section of eight stalls being isolated by a fire wall. His answer to a criticism for using such cheap construction, on a railway which could afford the best, was: "I have been compelled to tear down many fine structures built of brick and stone, by my predecessors and I do not want to bequeath to my successors any qualms of conscience." This replacement of permanent construction was demanded by a rapidly growing railway, which had outgrown its early facilities.

Besides the danger of obsolesence due to increased size of locomotives, it frequently is found that even the main repair shops have been erroneously placed and that better service can be rendered from some other point. If inexpensive buildings have been erected, the move can be made as soon as its desirability is clearly demonstrated.

Water Stations.—On most lines, there will be a few logical, or arbitrarily fixed locations for water stations, though the extent of demand on even these may be affected by the growth of traffic and the methods developed for handling it. To afford flexibility in meeting future demands, it usually will be better to provide for only a moderate increase over the estimated needs of the first few years. This will hold down the initial investment and no heart aches will be caused if it should be found necessary to move some of the stations.

Station Buildings.—The same general principles will apply to these facilities as have been stated for repair shops and water stations. Even at the outset, reasonable conveniences and protection should be afforded to passengers, and full protection to freight; but the higher refinements of permanent buildings, station parks, soft seats and similar accessories may well be left until the line is on a sure financial basis, or until outside competition makes necessary, the addition of some of these decorative features. Here again, there is always the possibility that after a few years of operation, a change may be found desirable in order that some important center may be served, or that full advantage may be taken of a new feeder system of highways.

Rolling Stock

The size, capacity, and type of rolling stock are so intimately related to the standards of permanent way that are maintained, that one can not be discussed intelligently without considering the limitations of the other. On lines using the minimum weight of rails, economy usually will be served best by employing the largest capacity of rolling stock which the track will permit but, as will be shown later, this will be true of the heavier lines only under certain special conditions.

Locomotives.—No effort will be made to discuss the types of locomotives best suited to various classes of service, other than as regards the two most essential and vital features; axle loads and tractive power. With the minimum volume of traffic, a locomotive of somewhat lesser weight than that fixed by the rails might serve but with 35 lb. or 45 lb. rails, it is doubtful if such a saving in first cost would be justified. A train can be hauled by a locomotive having 25 per cent excess of power, with no appreciable waste but if the locomotive is that much under-powered, the additional cost of operation will be excessive, resulting in slow speeds, doubling over hills, payment of overtime to crews, etc.

Goods Cars.—The transportation problems of this country, especially as they affect, and are affected by, the size and type of cars employed, are so peculiar to each locality that no one may assume that because a certain car has proven satisfactory in other localities, it should be adopted generally in China. Experience gained in other countries can be applied locally only if the governing conditions are known to be identical, or at least, comparable. There is one question however which has been given much attention in American and European countries which appears to have a close parallel in this country; this being the question of open *vs.* closed goods cars. Probably more on account of the longer average hauls, closed cars are more in demand in Canada and the U.S.A. than in European countries. In the matter of length of haul, it is reasonable to expect that as they become further developed, the railways of China will more nearly compare with those of the American continent than with those of Europe and that it will be found desirable to increase the number of closed cars employed.

While certain commodities can be handled as well in open cars, and others could not be handled successfully in any other type, the closed car has many advantages in the transportation of materials which can be loaded into them conveniently, some of these advantages being:

Protection against the weather and pilfering.
Lower insurance rates.
No tarpaulins to be mislaid or stolen.
If properly locked, it is not necessary to send a special man to accompany the shipment.

Including as "closed cars" all stock, poultry, and tank cars, of the railways of the U.S.A., these constitute more than one half the total number of freight cars in service, the detailed distribution being as shown by Table VI.

Table VI.—Freight Cars of various types in use on the railways of the U.S.A. in 1925, as reported by the American Railway Association.

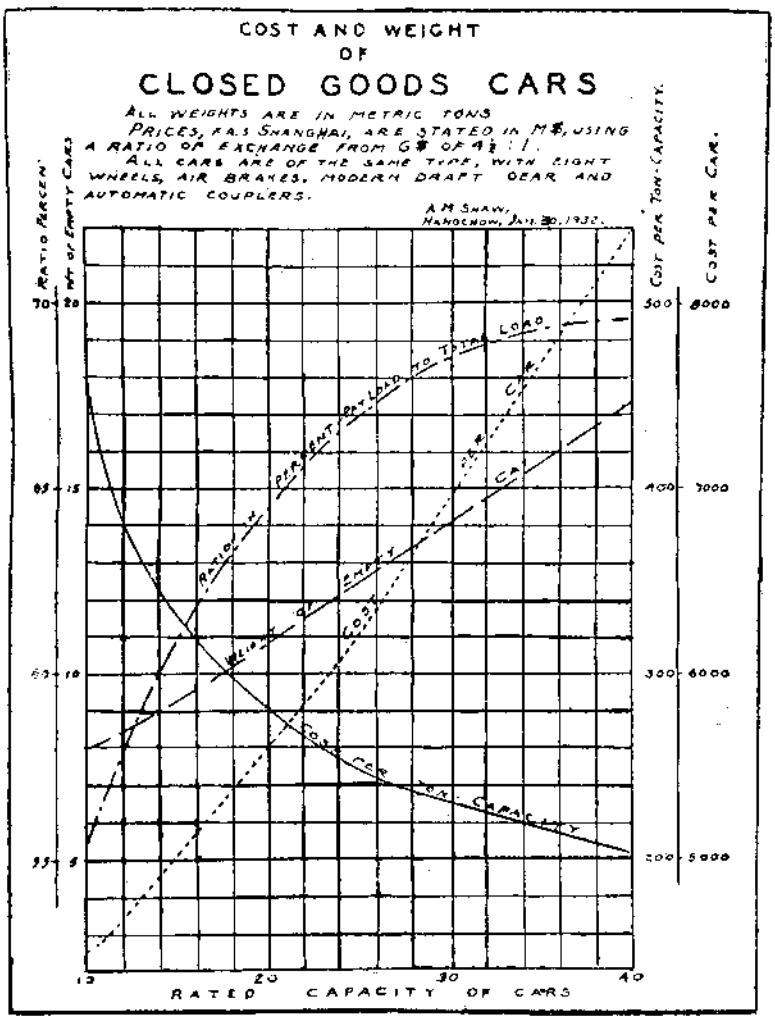
	No. of cars in service	*Percentage*	*Totals No. of cars*	*Percentage*
Closed Cars.				
Box, Plain	1,029,663	33.8	—	—
Box, Special	195,180	6.4	—	—
Stock	97,483	3.1	—	—
Poultry	2,327	.1	—	—
Refrigerator	146,825	4.8	—	—
Tank	148,637	4.9	1,620,115	53.1
Open Cars.				
Flats	137,461	4.5	—	—
Gondolas	573,180	18.8	—	—
Hopper and Coke, etc.	545,070	17.9	1,255,711	41.2
Miscellaneous and Non-Revenue	—	—	172,147	5.7
Total			3,047,973	100.0

Especially in the U.S.A. and Canada, many special types of cars have been introduced for the main purpose of saving labor in loading and unloading. With the present low labor costs in this country, many of these would be an unnecessary luxury though for such commodities as coal, bottom-dump or tipping cars should show an economy if the terminal facilities are designed for their use.

It probably is the size and the capacity of individual cars which should be given the most careful attention, as the economical limits of these most vitally affect the economy of operation. Owing to the variation in governing conditions in other countries, exact parallels which might serve as a guide in such matters, do not exist. Even on a given line in this country, methods of production and merchandizing may, and undoubtedly will, undergo a change which will have its effect on both the amount and character of service to be rendered by the railways.

As an aid in the study of the effect of size of car units on cost, the accompanying graph has been prepared. This is based on size, weights, capacity and cost of closed goods cars, fully equipped, though cost and other details of open cars will run approximately parallel to these.

A novice might deduce, from this graph, that the cheapest car to purchase is the largest car though, while this will prove to be the case under certain very specialized conditions, it requires but a most superficial study to demonstrate the fallacy of the idea as applied to


COST AND WEIGHT
OF
CLOSED GOODS CARS
ALL WEIGHTS ARE IN METRIC TONS
PRICES, F.A.S. SHANGHAI, ARE STATED IN M$, USING
A RATIO OF EXCHANGE FROM G$ OF 4½ : 1.
ALL CARS ARE OF THE SAME TYPE, WITH EIGHT
WHEELS, AIR BRAKES, MODERN DRAFT GEAR AND
AUTOMATIC COUPLERS.
A.M. SHAW,
HANKOW, JAN. 30, 1932.
RATIO PERCENT WT. OF EMPTY CARS
COST PER TON-CAPACITY.
COST PER CAR.
PERCENT DEAD LOAD TO TOTAL LOAD.
RATIO OF WEIGHT OF EMPTY CAR TO COST
COST PER TON CAPACITY
RATED CAPACITY OF CARS
10
20
30
40

the local railway situation in general. The strength of the track, as determined by the section of rail employed, is only one of the determining factors. Practical limitations of loading, as fixed by cargo available, is frequently of even greater importance.

While there are no figures available on which to base such a statement, it appears probable that for the lightest railway described in the foregoing, the maximum size car which the track will support should be employed, this affording a capacity of twelve, or possibly fifteen tons. Special conditions may dictate otherwise though this is doubtful, on account of the very rapid increase in cost (per unit of capacity) of the lower-capacity cars. It should be noted in this connection, however, that the ratio of cost to capacity, as indicated by the graph, will not hold true in regard to four-wheel cars though these have not been considered for use on the lightest lines as the load of even a twelve-ton car, supported on only four wheels, would be beyond the safe limits of 35 lb. rail. It is quite possible, however, that on heavier lines, the use of four-wheel cars may be warranted to meet certain conditions.

On large systems, there is no economy in holding to one standard size of cars if traffic conditions can be met better by the use of two or more sizes, though within reasonable limits, standardization has many advantages. At least the couplers, draft gear parts which require frequent renewal, wheels, journals, journal bearings, and similar parts, should be standarized as fully as possible.

Even in countries which are exceptionally well suited to secure maximum car loading, it is found that the actual loading of cars is far below the theoretical capacity. In his book on *Railroad Freight Transportation*, Loree states that, in spite of the great industrial centers in the U.S.A. and other factors which tend toward full loading of cars, the official records for the year 1918 showed an average loading of all freight cars of only 10 tons per car, though the average capacity of these was 30 tons per car.

Loading to theoretical capacity can be more nearly reached in some classes of service than is possible in others. As an illustration, cars loaded with coal at the mines frequently carry 10 per cent more than their rated capacity. As there is every inducement for full loading at the mines, it is seldom that a car is sent out without its capacity load, the result being that cars which are engaged exclusively in hauling coal from mines may average capacity loading, in one direction. The return trip necessarily will be made with light loads, if not with empties. In such service, it may be seen from Table VII that the best showing is made by the largest-capacity car which it is practicable to operate, even when all cars are returned empty.

TABLE VII.—RELATION OF CAR CAPACITY TO PAY LOADS HAULED (IN COAL SERVICE) ASSUMING 100% LOADING FROM THE MINE AND RETURN TRIPS TO BE MADE EMPTY. ALL WEIGHTS IN METRIC TONS.

Rated capacity of car	*Per cent of Total*		*Tons kilometer haul of car, per ton-kilometer haul of pay load*
	Pay load	*Car*	
10	51.0	49.0	1.92
12	53.8	46.2	1.72
15	57.2	42.8	1.49
20	61.7	38.3	1.24
25	64.8	35.2	1.09
30	66.9	33.1	0.99
35	68.7	31.3	0.91
40	70.0	30.0	0.86

By considering Table VII in connection with the graph showing the cost of cars, and assuming that the cost of coal cars will run parallel to that of the closed goods cars it will be seen that both in first cost (per unit of capacity) and in cost of operation, the maximum of economy is secured by the use of the larger units. In no case, however, would it be wise to adopt a car size which is not well within the limits fixed by other facilities, such as track, track structures, cargo handling facilities, etc.

FINANCIAL.—Together with a full realization of the needs of the country for an extension of its means of transportation, there must be a practicable, workable, and far-seeing plan for financing the railways that so obviously are required.

Many advocate full Government ownership and operation, while others hold to the opinion that additional railways can be obtained in sufficient numbers only by the use of private capital.

Without attempting to discuss the relative advantages of Government *vs.* private ownership, it might be well to consider some of the phases of each, as they may be assumed to have a bearing on the rate of railway construction of the near future.

To build a railway as a Government-owned project, with a view to Government operation, it will be necessary that it be constructed, either by the use of funds from the public treasury; or capital must be borrowed for the specific purpose, pledging as security, the physical properties of the railway and its revenues. With the existing tremendous and unescapable demands on the funds and credit of the Nation, the former course scarcely appears to be feasible, while the latter undoubtedly would require so many concessions, in the form of guarantees to the private investor, as to practically defeat its purpose.

While it may be generally conceded that, for military and political purposes, certain lines should be as nearly as practicable under complete Government control, it is apparent that if private capital is to become interested on a large scale, sufficient inducement in the form of a reasonable return on the investment must

be offered and this object can be secured best through private ownership and management.

Assuming that private capital (both foreign and domestic) is to be invited to assist in the extension of the present railway system, there remains to be established a general policy under which such ventures are to be administered. Past experiences, both in China and elsewhere, appear to have established certain fundamental truths in regard to railways which have become almost axiomatic: while the satisfactory solution of other, and perhaps fully as important problems, has not yet been reached. Two of these generally accepted principles may be stated as follows:—

> Judged purely as a private investment, for private gain, a privately owned railway, operating with a minimum of governmental supervision and restrictions is more efficient than a railway which is owned and operated as a Government enterprise.
>
> As opposed to this, civilization has advanced too far to tolerate an industry which so vitally affects the prosperity and welfare of the whole Nation, as does an important railway, to be exploited with regard only to the profits accruing to private capital.

There is no known method by which all of the advantages of each may be secured, without its attendant evils. The nearest approach to such a plan would appear to be one which would provide State control in matters affecting the interests of the public, leaving the details of management in the hands of private capital. If it is decided to invite capital to participate in such a development, the desired co-operation doubtless can be secured most readily by adopting and promulgating a definite policy regarding the relations which it is proposed to establish between the State and investors. An attempt to anticipate, in minute detail, the requirements to be imposed, doubtless would be undesirable, but the fundamental principles might well be given. These should be sufficiently liberal to attract capital, but should protect the public from any possibility of exploitation. The degree of liberality to investors necessarily would be greater during the earlier years than would be required after the country has become fully stabilized and the general system of administration perfected.

The following points appear to be worthy of consideration in connection with such a plan:—

1. The least possible interference by the State, with the affairs of the railway, consistent with the interests of the public.
2. Maintenance, by the railway, of a State-supervized, standard system of accounting.
3. Provision that annual net profits from operation, not exceeding an agreed maximum, shall be retained by the investors as their return on the capital invested.
4. Provision that profits in excess of this specified maximum shall be devoted to:

(*a*) Reimbursement to investors, to cover any shortage, below the specified maximum, which may have been suffered in any previous year of a term of limited duration, say a period of five years.

(*b*) Any remaining balance to be divided on an agreed basis, between the State and the investors.

5. Provision for taking over by the State, on a previously specified, equitable plan, and at the expiration of a specified period, of the entire property.
6. Provision for taking over, by the State, as a temporary measure and during a time of extreme emergency, including a provision for equitable reimbursement, the entire property or any part of it.

Provisions five and six, together with stipulations regarding such subjects as: character of service to be rendered and minimum amount of service; standards of construction; general route; training Chinese employees in responsible position; limiting numbers of foreign employees and other details might well be left for adjustment to each individual enterprise. It is well to remember, however, that provisions relating to acquisition by the state, either as a temporary or a permanent transfer, must take full cognizance of the generally timid attitude of prospective investors when such features are involved. Unless these investors can be assured of equitable treatment, they will seek another investment, perhaps promising a smaller net return, but one which appears to them to be less hazardous.

Without, in any way, sacrificing its sovereign rights, the State is compelled to recognize the fact that an agreement which contemplates the transfer of a franchise, in consideration of a specified investment is, in the most of its essentials, the same as a contract between two individuals. Any plan which does not provide equity, justice and protection to both parties to the contract is doomed to failure.

Only with the fullest knowledge of the needs and the limitations of the country, coupled with an appreciation of the resources and limitations of private capital, will it be possible to devise a plan which will secure to the people the greatest measure of service and benefit and, at the same time, be sufficiently attractive to investors to secure their interest.

Conclusion.—Methods which have been developed in other countries may be studied to good advantage by economists who are striving to give to China the efficient transportation system to which her people are entitled, and which her economic conditions demand, but not even the best of such methods may be adopted blindly. Each must be given a most careful study and, in most cases, this study will show that substantial modification of methods and standards are required if they are to be of the greatest service in this country. Unique problems are presented which are without close parallels in the growth and development of transportation systems in other sections. In the aggregate, these will have a great influence on the design, and methods of operation of the railways of the country. In the following are mentioned some of these problems which are either peculiar to China or which, at least, do not exist in so marked a degree in other countries.

China is one of the largest countries of the world, both in area and in population, but with railways amounting only to about five miles for each million of population, and even with that small mileage very unevenly distributed.

The economic development of the country, which has reached an advanced stage without adequate transportation, may be expected to undergo a gradual change as modern facilities are provided, revolutionizing agriculture as well as industry. Crops which are not well suited to a given section will be abandoned, permitting that section to devote its resources to more profitable staples, and to supply its needs of the items previously produced, from other sections which are better suited to their production. From this cause alone, there will be built up a traffic which will be advantageous to all concerned but which now is practically non-existent.

Shipments of cereals will continue to be made in small lots until there gradually comes a readjustment which will follow with better transportation systems. It is probable that a concentration of such shipments will later be effected through some sort of private or Government purchasing agency. If properly operated, such a central agency would be a benefit to the producer, the consumer and the transportation systems. Of particular interest to the latter will be the resulting increase in total volume of traffic and also the delivery of produce in quantities which will permit more economical handling.

There are now comparatively few mines and no large industrial establishments demanding a daily supply of whole trains of cars to handle their output though the gradual evolution which will result from the construction of an adequate transportation system will eventually result in such demands.

The development of highways, and truck transportation present new features and possibilities for the creation of a comprehensive transportation system, affording opportunities which have not existed in other countries, where the railways have been developed without regard to a logical relation with other methods of handling goods and passengers.

Many of the canals of the alluvial plains will be abandoned, or used only for local transportation and as drainage and irrigation canals, while some of those which are strategically located will be improved by the addition of gravity locks and arranged for hauling of special commodities by power. In a like manner, navigation on some of the smaller rivers will be abandoned on account of the difficulties which it will not pay to overcome, while other river will be improved by control works, dredging and the construction of canals and locks for passing difficult sections.

If properly planned, canal and river improvement, highway development and the construction of additional railways, all will be

designed to combine into a logical national system of transportation.

A discussion of the railway problems of the country should not close without some attention being given to the human element which will enter into their construction and operation. This is desirable not only on account of the peculiar conditons of labor in this country, but because it is a feature which has been given all too little attention by economists of other countries, in their writings of railway matters. In the excellent book already referred to, President Loree brings this matter forcibly to the attention of his readers. In quoting from a talk which he gave before the American Railway Engineering Association, he shows that the published "Proceedings" of that Association (which in 1912 had reached a total of 9,000 pages) could be divided into the following classes :—

Problems of Roadway	12%
,, ,, Track	30
,, ,, Major Structures	28
,, ,, Minor Structures	15
,, ,, Miscellaneous	15
	100%

Even under "Miscellaneous," practically nothing was found which treated of the human element of railway construction and operation.

Following this analysis, the author states that the cost of maintenance of the railways of the United States amounts to $300,000,000.00 per annum, of which 56 per cent is paid out as wages. He follows this with the statement that—"it would seem to justify the suggestion that your Association devote at least a substantial portion of its work to the study of labor." As a result of this suggestion, the A.R.E.A. has created a special committee which has taken up the study of labor as affecting the problems of railway maintenance.

It is probable that in China, labor does not constitute quite so high a portion of the total cost of maintenance, yet it certainly is the largest single item of cost and is a subject which well may be given attention by every man occupying an executive position.

Regardless of whether the railways of the future are to be Government owned and operated, or operated by private interests under Government control, establishing and maintaining proper relations between employer and employee in the railway service will become of increasing importance, not only to the railways alone, but to the entire Nation. As the railways grow in mileage, and in number of employees, this relation will be found to carry an influence far beyond the limits of the railway organization, tending toward stabilization, or disruption, of relations with labor in other channels.

With just treatment of labor and the managing staff, fair wages, the cultivation of a feeling of security of employment so long as loyal service is rendered, and intelligent supervision, there can be developed an esprit de corps which will make for higher standards of performance, lower operating costs, and generally better service—the railways will be efficient, smooth-working public utilities, contributing to a tremendous degree to the welfare of the country. Without these, there will be chaos, inefficiency and a general breakdown in the railways which will have a disastrous effect on the entire Nation. It will rest with the men who are delegated to direct the policies of the railways, whether these are to be models of efficiency, or deplorable examples of inefficiency.

ACKNOWLEDGMENT.—In addition to the three works, from which direct quotations have been made, valuable suggestions were secured from *Economics of Rail Transportation in Great Britain* by C. E. R. Sherrington; *Railroad Administration*, by Ray Morris; and *Government Ownership of Railways*, by Walter M. W. Splawn.

The work has been made possible, and was inspired by, the association of the writer with the technical staff of the Hangchow-Kiangshan Railway during the three years of planning, surveys, construction and initial operation of that line, which is now in service from Hangchow to Lanchi. Special assistance has been rendered by the Director and Engineer-in-Chief, C. Y. Tu; the Engineer of Bridges, C. Y. Hon; and the Chief of the Mechanical Department, Easin Mao.

Information regarding transportation costs was kindly furnished by various agencies, especially the Shanghai office of Thomas Cook and Son and the staff members of the Chinese Maritime Customs. Dealers and manufacturers of railway equipment furnished much valuable assistance.

Dyestuffs in Japan

IN 1931, reports the U.S. Assistant Trade Commissioner at Tokyo ("Commerce Reports," June 13, 1932), there were thirty-six dyestuffs producers in Japan, whose capital invested totalled Y. 21,000,000 and whose annual production amounted to 9,000,000 kilogs, valued at Y. 9,000,000. The Japanese Government lists thirty dyestuffs, on which it pays subsidies to manufacturers, twenty-nine of which are produced locally. The Japan Dyestuffs Manufacturing Company, the Miike Dye Factory, a branch of the Mitsui Mining Company, the Teikoku Dyestuffs Manufacturing Company, and the Hodogaya Soda Company all produce certain of the specified dyes on which subsidies are paid.

THE AGREEMENT WITH GERMANY

The import tariff of Japan has been changed from time to time in order to give protection to the domestic industry, and in 1928 a commercial treaty was signed with Germany whereby that country undertook not to export to Japan dyes which could be manufactured there. Other German dyes are still imported under a licence from the Department of Commerce and Industry.

JAPANESE PRODUCTION AND IMPORTS OF DYESTUFFS

(Quantity in kilogs; value in yen.)

Dyeing Class	*Production*	*Imports*	
	1930	*1930*	*1931*
Basic.			
Quantity	257,632	153,700	163,968
Value	1,071,580	1,011,154	1,040,874
Direct.			
Quantity	605,635	436,230	475,066
Value	1,699,210	1,338,188	1,639,404
Acid.			
Quantity	239,966	213,828	273,829
Value	647,150	888,224	1,108,301
Mordant and acid mordant.			
Quantity	52,688	198,908	255,198
Value	213,955	626,504	989,924
Sulphur.			
Quantity	6,472,947	83,977	97,651
Value	2,312,311	266,345	275,994
Artificial indigo.			
Quantity	94,452	397,950	594,525
Value	431,524	970,817	1,328,790
Other vat.			
Quantity	40,393	85,567	108,990
Value	103,304	604,325	777,857
Other colours.			
Quantity	-	24,490	28,599
Value	—	103,679	124,312
Total:			
Quantity	7,763,713	1,574,650	997,826
Value	6,479,034	5,809,236	7,285,456

The local dye production does not meet domestic demand. The manufacture of artificial indigo has been started, but production amounts to but 25 per cent of requirements. The production of dyestuffs during 1930, the last year for which figures are available, and imports during the past two years, are shown in the table. Japan has been shipping sulphur black to China since 1916, but during 1931 exports of 2,011,752 kilogs, valued at Y. 509,459 were small. During the second half of 1931 the Japan Dyestuffs Manufacturing Company showed a net profit of Y. 250,000 Earnings for other companies are not yet available, but it is believed that each of them made a fair profit. The factories are well equipped, experimental work is progressing, and the industry as a whole may be said to be in good condition, despite the depression.—*Chemical Trade Journal.*

Engineering Notes

INDUSTRIAL

RAYON MILL.—Messrs. Sumitomo Goshi Kaisha, Ltd., are arranging to erect a large new rayon mill near Yokohama.

NEW BUILDING.—Tenders are being invited for the construction of new four-story building for the Chinese Ministry of Foreign Affairs, at Nanking. The structure is estimated to cost $600,000 and an appropriation from the British portion of the Indemnity Refunds, has been secured for the work.

SIAM GETS BREWERY.—As a result of Phya Bhiromya Bhakd's recent European tour a beer brewing plant, valued at Tcs. 400,000, will soon arrive in Siam as per the Chao Khun's order. A German expert will also come out to erect the same. At present Nai Prachuab Sreshthabutr, son of the Chao Khun, is prosecuting further studies in Germany.

CANTON PROJECTS.—The Mayor of Canton, Mr. Liu Chi-wen, announced that the local municipal authorities were contemplating two huge industrial projects.

The first of these, he said, would be a large gas works and the second a new steel bridge across the Pearl River in addition to the bridge now under construction, which will be opened in the New Year.—*Reuter.*

SHOWA STEEL PLAN.—A conference is to be held in Tokyo shortly to settle details of the Showa Steel Works plan. This question has been pending for three years. The factory is to be built at the Anshan Iron Works. Capitalization will remain at Y.100,000,000. The hot process, in which the molten iron from the smelters is run direct into the steel furnaces without being allowed to cool, will be employed.

NEW POWER PLANT.—Despite financial stringency as a result of the Yangtze flood disaster last year, during the period of which a heroic effort was maintained throughout to supply water to the entire population, the management of the Hankow Waterworks & Electric Light Co. is now undertaking to erect a new electric power plant and also planning to extend and improve present methods of supplying water to the city.

TO HARNESS YANGTZE.—Engineers of the Ministries of Communications and Industry and the National Reconstruction Commission are conducting an inspection of the Yangtze River to study the possibilities for hydro-electric development. It is understood that upon conclusion of the tour a Water Power Conference will be called to discuss steps for realizing the project to construct a hydro-electric station for the harnessing of the mighty Yangtze to industrial purposes.

RAILWAYS

RAILWAY LOAN.—A loan agreement between Chekiang and a financial syndicate at Shanghai for the completion of the Hangchow-Kiang-han Railway has been drafted. To obtain funds for the completion of the line, the provincial authorities have agreed to transfer control of the Hangchow, Yashih, Yuhang, and Szean electric works as security.

TOKYO UNDERGROUND.—The Tokyo Rapid Transit Co. (in process of formation, with a capital of Y.30,000,000) has applied for permission to take over from the Tokyo Municipality the latter's chartered underground lines. Some forty leading business men are interested in the enterprise, and it is expected that the railway authorities will grant the application.

RAILWAY LOAN.—The issue of a $32 million loan for the redemption of the Japanese mortgage on the Kiaochow-Tsinan Railway has been definitely decided upon by the Board of Directors of the Railway. According to Mr. Ko Kwang-ting, Chairman of the Administrative Committee of the Railway, the loan will be issued either by the Ministry of Finance or the Railway Administration. This will be decided by the National Government.

RAILWAY LOAN.—The Chinese Vice-Minister of Railways, Mr. Tseng Chang-min, announces that the Ministry of Railways is contemplating the floatation of bonds to the value of £2,400,000 for the completion of the Chuchow-Shanchow section of the Canton-Hankow railway and for the purchase of railway material. The security, he said, would be the relinquished British share of the Boxer Indemnity due during the period between January, 1937, and December 1946.

TAKES OVER LINE.—It is announced that the Chinese authorities have taken over the Cheng Tai Railway upon the expiration of this year's loan agreement with the French Company, Societe Francaise de Construction et d'Exploitation de Chemins de Fer en Chine. The Cheng Tai Railway connects Taiyuanfu, in Shansi, and Shihkiachwang. It is 151 miles long and its construction was undertaken in 1904 with a French loan of F. 49,000,000 and Government capital of over $6,000,000.—*Reuter.*

LUNG-HAI RAILWAY WORK.—Construction of the road-bed for the eastern extension of the Lung-Hai Railway from Sinpu (Huichow) to Hsukow, on the Kiangsu coast, having been completed, the laying of the tracks has commenced, with the arrival of a large shipment of rails. In view of the shallow harbor at Sinpu, ships of comparatively deep draught are unable to enter. The Ministry of Railways has therefore planned to build a harbor at Hsukow opposite Siling-tao (island) and extend the railway to that point.

CHINESE LIGHT RAILWAYS.—The Chinese National Reconstruction Commission is reported to be contemplating the construction of two light railways. One of these will be between Chupu, Chekiang, and Wuhu, Anhwei, while the other is to run from Lohsu to Luchow, both of which are towns in Anhwei. The two projects are estimated to cost about $2,000,000 (Mex.) The first will be financed by annuities payable to the Reconstruction Commission by the Changhsin Colliery, while the capital for the second project will be raised by means of public subscriptions.—*Reuter.*

THE TANNA TUNNEL.—A tunnel which on completion will be 4.8 miles in length in the Izu Peninsula in Japan is attracting keen attention in engineering circles. It is the Tanna tunnel. Started more than fourteen years ago, to date a sum of Y.21,500,000 has been spent, and it is probable that more than Y.3,000,000 must yet be spent before the work is finished. The tunnel on completion will be 25,614 feet in length. Of this length, 2,200 feet yet remain to be penetrated. The Tanna tunnel will replace the Gotemba route, skirting Mount Fuji. The interior of Tanna mountain was found to contain hundreds of water veins. Sometimes the workers struck geysers, which paralyzed work for months. At other times, due to earthquakes, crevices broke out in the tunnel and its level deviated as much as six feet. Due to difficulties, the cost of Tanna tunnel is reported to be unparalleled in tunnel construction. The per foot cost is set at Y.969. Great casualties have been taken by cave-ins and sudden on pourings of water. At present the water gushing from seventy crevices within the tunnel amounts to 26 cubic feet per second from the Atami entrance. The Construction Bureau of the Railway Department hopes to penetrate the remaining 2,200 feet some time next year.

SHIPPING

PORT WORK HALTED.—The construction of port facilities at Hulutao, at the terminus of the Tahu hun-Tungliang Railway, will be temporarily suspended on payment of part of the loan by the South Manchuria Railway Company to the Dutch company who undertook the project. The works are being taken over by the Manchukuo authorities, according to reliable information.

YANGTZE BRIDGE.—An iron bridge to span the Han River and connect Hankow and Hanyang is one of the schemes designed by Dr. Wu Kuehen, Mayor of Hankow. This will be submitted at the first meeting of the Provisional City Council which is now in process of formation, the members of which will include some prominent foreigners. In the event of this scheme being adopted one year will be the period necessary to complete the construction of the bridge, it is reported.

AVIATION

CANTON AIR FORCE.—Canton, resolved to build up a large air force, has a three-year plan, and preparations are under way for the completion of the first stage. The plan of the military authorities is to bring into existence within the next three years an air force composed of 400 fighting planes. At present Canton has about 40 machines. It is learned that plans adopted also call for the engagement of 30 German aviators for training the Cantonese army fliers.

COMMUNICATIONS

NEW HIGHWAY.—The construction of a highway from Pukow, Kiangsu, to Sinyang, in Honan has been approved by the Chinese Ministry of Railways. The Anhwei and Honan Provincial Governments have accordingly been requested to draft plans and raise funds for the building of the new road. The proposed highway will run south of the Lung-Hui Railway and will cut across central Anhwei into Sinyang, southern Honan.

DYKE CONSTRUCTION.—In order that maximum progress may be made in dyke construction and flood prevention work, the Commander-in-Chief's Headquarters for the Honan-Hupeh-Anhwei Bandit-suppression Forces, in a dispatch to the National Economic Council, instructs that funds and revenues earmarked for this work shall not be diverted to other purposes. The dispatch also states that levy of the authorized Customs Surtax, Special Surtax, and Farm Surtax imposed especially for dyke construction purposes should be continued as heretofore.

RADIO IN JAPAN.—By 1934, it is expected that Japan will have perfected equipment for direct radio-telephone service from Tokyo to Europe, America, Java, Hongkong, Shanghai, Dairen, Formosa, and with ships at sea. This is to be done by the International Wireless Telephone Company which is being promoted by Baron Yoshiro Fujinuma and Messrs. Fusajiro Abe and Shintaro Ohashi. According to present indications, the call fee between Japan and Dairen and Formosa will be Y.8, between Japan and Hongkong Y.12, between Japan and Java Y.20, Japan and America Y.70, between Japan and Europe Y.80 and from Japan to ships at sea Y.25. These fees cover three minute calls in each instance. Actual work on the instalment of the equipment will be begun early in 1933 and it is expected that it can be completed in a year.

ENGINEERING FINANCE COMMERCE

THE FAR EASTERN REVIEW

上海黃浦灘念四號

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THE FUTURE OF CHINA

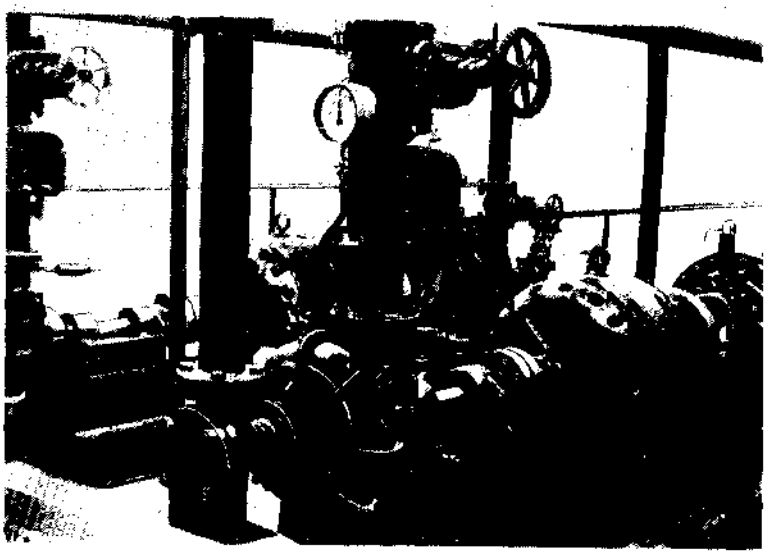
JAPAN'S FOREIGN POLICIES

THE RECLAIMED MAN-MŌ

JAPANESE SHIPPING AND SHIPBUILDING

Vol. XXIX FEBRUARY, 1933 No. 2

"Stereophagus" Pump Plant at the Llansamlet Pumping Station showing view of three Electric Motors A/C 15 b.h.p. Each Driving one of Pumps below with Vertical Spindle



"Pulsometer" High Head Sewage Pumping Plant at Tadworth for Epsom Rural District Council consisting of a "Stereophagus" Motor Driven Pump in series with a Motor Driven High Pressure Centrifugal Pump of ordinary type

"Stereophagus" type with 4-in. suction, which discharges through a 3-in. pipe to the high-pressure centrifugal pump constituting a highly efficient combination able to deal direct with crude sewage without choking. Also there is full utilization of the inherent advantages of the centrifugal pump, including low capital cost, small floor space, and simplicity of operation and maintenance, while the installation is equipped with the firm's standard arrangement of automatic control with special float gear.

Further in connection with the Far East it may be stated that a notable installation of "Pulsometer" turbine pumps is at the Tientsin Waterworks, consisting of three 6-in. horizontal split, single-stage turbine pumps, one of which delivers 500 gallons of water per minute against a head of 135 feet, while the other two are rated at 1,000 gallons per minute, also at 135 feet head.

Each pump is direct driven by an A.C. motor, for the smaller size the unit being 30 b.h.p., while for the two other pumps 60 b.h.p. is required. Interesting also is that one of the 1,000 gallon units has the spindle extended at the back end and is arranged so that auxiliary drive can be immediately started up from a petrol engine in the event of any failure in the supply of electricity, the whole equipment being complete with motor-driven rotary exhauster.

Purchasing for the S.M.R.

Assistant Trade Commissioner C. E. CHRISTOPHERSON, Mukden

ONE of the more important and interesting departments of the South Manchuria Railway Co. is its purchasing and stores department, which does all the purchasing for the varied interests and activities of the company. In addition to the railway, these activities include the Fushun coal mines and shale-oil plant, the Anshan Iron Works, experimental farms, laboratories, schools, hospitals, and hotels. In addition to handling purchases and stores, this department also operates the company printing plant and a creosoting plant.

Description of Headquarters at Dairen

The department consists of six main sections—the general section, the planning and accounting section, research section, purchasing section, Dairen stores section, and Mukden stores section. The Dairen stores section is divided into three subsections, namely, material-controlling, shipping and receiving, and repairing and disposing. In addition to the Dairen office the two stores sections operate branches in Antung, Changchun, Kaiyuan, Wa-Fang-Tien, Ta-Shih-Chiao, and Ssu-Ping-Kai.

The main office of the purchasing department is located on the top floor of a modern 5-story building near the water front in Dairen. In addition to two large freight elevators, this building is equipped with powerful overhead cranes located immediately under the roof, which operate through a large opening, or hatch, in the center of the building extending to the ground floor. This arrangement not only facilitates the handling of large cases and heavy machinery, but enables supplies to be moved rapidly from floor to floor through the hatchway.

In passing through the building one may see neatly arranged stocks of everything, from huge generators, engines, and automobile trucks to cooking utensils, tooth brushes, and well-known patent medicines. Each floor also has its own small laboratory for testing the various commodities received. The printing plant and creosoting plant are in separate buildings, and there is also a large receiving yard, where rails, iron and steel, and other bulky items are received and stored.

Annual purchases of the railway formerly reached from Y.30,000,000 to Y.40,000,000, but in 1931, owing to depressed conditions, this total dropped to Y.20,000,000. (The yen averaged $0.4885 in 1931.) Approximately 50 per cent of the purchases are from foreign countries, the remaining 50 per cent being from Japan and China. The chief products purchased from China are cement, wood and ties. Approximately 45 per cent of the foreign purchases are made through three large Japanese firms, distributed as follows: Mitsui, 20 per cent; Mitsubishi, 15 per cent; and Okura, 10 per cent. The rest, for the most part, is purchased from 25 Dairen firms. During the past three years purchases from foreign countries have been reduced approximately 10 per cent.

Requisitions for supplies and equipment generally originate in the section where the goods are to be used, and the purchasing department is requested to make the necessary purchases according to that section's requirements and specifications. Purchases are generally made through bids, which are usually issued only in Dairen, generally two weeks before date of opening. For special items bids are occasionally sent to foreign countries, in which case two months is generally granted before opening.—*Commerce Reports.*

Engineering Notes

INDUSTRIAL

BUYS BRITISH CARS.—British motor-cars are gaining ground in the Far East where several self changing 20 h.p. Armstrong Siddeley cars have recently been ordered by the Imperial Japanese Army. These cars are completely finished in one color, *i.e.*, grey or khaki. —*Worcester Daily Times.*

PULP MANUFACTURE.—The Oji and Fuji Paper Companies of Japan, have turned their attention to the manufacturing of pulp for rayon. These companies have been encouraged by the action of the Karafuto Industrial Company. The remarkable development of the rayon industry in Japan has caused the demand for pulp to increase rapidly. The consumption a few years ago was only 32,273,000 lbs., but this had increased to 64,218,000 lbs. in 1931. Seeing this active consumption, the Karafuto concern, which had hitherto been chiefly supplying pulp for paper manufacturers, decided to start making pulp for rayon.—*World's Paper Trade Review.*

BANGKOK PRISON SCHEME.—Phya Ajyachakra, Director of the Prison Department, applied to the Siam Ministry of Finance for funds with which to acquire the necessary machinery to start a weaving factory in the prison. If the suggestion is taken up, Government will buy cloth from the Prison Department for use in the Army and Navy, the police and the prisons. It is calculated that the annual quantity of cloth required is about 800,000 yards for these departments alone. The capital required to bring the scheme about is something like Tes. 300,000. It is mentioned that the contract to supply the machinery will be given to Messrs. Windsor and Co.

HYDRO-ELECTRIC POWER.—Thirty-five applications have been received by the Korean Government for permission to establish hydro-electric undertakings in Korea. The most important are those of the Korean Electric Industrial Co. (capital Y.30,000,000), the Korean Electric Power Co. (capital Y.50,000,000), the Korean Nitrogenous Manure Co. (capital Y.50,000,000), the Seoul Electric Co. (capital Y.19,000,000), the Korean Railway Co. (capital Y.17,200,000), and the Korean Central Hydro-electric Co. (capital Y.10,000,000).

TOKYO RESERVOIR.—To free Tokyo from lack of a sufficient water supply during the summer months the construction of a vast reservoir in Nish-Tama Gun, on the outskirts of the city, at a cost of Y.39,000,000, has been approved by a special committee of the municipality. The proposed artificial lake will have a total capacity of 6,600,000,000 cubic feet of water. At present Tokyo is supplied from two main sources, one the Murayama reservoir and the other at Yamaguchi, which, although being used, has not yet been completed. When the proposed reservoir is completed the total supply for the city will be brought up to 1,320,000 cubic feet a day, which will be ample, even if, in the meantime, the population of Greater Tokyo reaches the 5,500,000 mark.

RAILWAYS

TOKYO UNDERGROUND.—The Tokyo Underground Railway Co. has been successful in arranging a loan of Y.5,000,000 for its underground railway scheme, and is expected to start work soon on the construction of a line between Kyobashi and Shimbashi.

BUILDING BRIDGES.—Construction work on the bridges for the Shiuchow-Lokchong section of the Canton-Hankow Railway has commenced and the entire section is expected to be completed by next May, according to a message received by the Chinese Ministry of Railways from Mr. Lin Hung-hsun, Director of the Engineering Bureau for the Chuchow-Shiuchow section of the Railway.

The biggest engineering undertaking for the Shiuchow-Lockchong section, Mr. Lin states, is the bridge near Shiuchow. If the wooden sleepers purchased by the Ministry for the Railway arrive according to schedule, trains will be running to Lokchong by next May.

RAILWAY IN MANCHUKUO.—About two years ago much was published regarding the construction of a railway from Kirin to Harbin, which was to join up the railway from Kirin to Tunhua and then through Korea to the Pacific at Seisin. The Mukden government refused to permit the construction of the line to the Korean frontier, and the project was postponed. The Japanese, however, continue their work at the port of Seisin, and with their occupation of Manchuria the construction of the line has been going on all the summer. By next spring the road from Kirin to the sea should be finished and that from Kirin to Harbin very nearly so. The Japanese plans have now been further increased by a scheme to unite the above railways with the Hu-Hai railway, by means of a bridge across the Sungari, north of the present C. E. R. bridge, and to construct a central station in Old Harbin where the Hu-Hai railway could join up with the Harbin-Kirin-Tunhua-Seisin railway lines. If the scheme is carried through it will be a death-blow to the Chinese Eastern Railway eastern section as well as to the port of Egersheld.

SULZER BROTHERS

SHANGHAI ENGINEERING OFFICE

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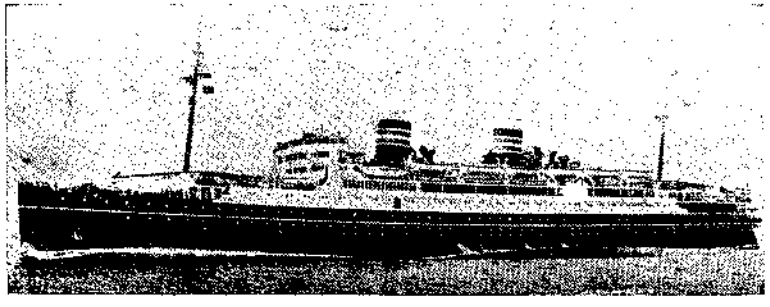

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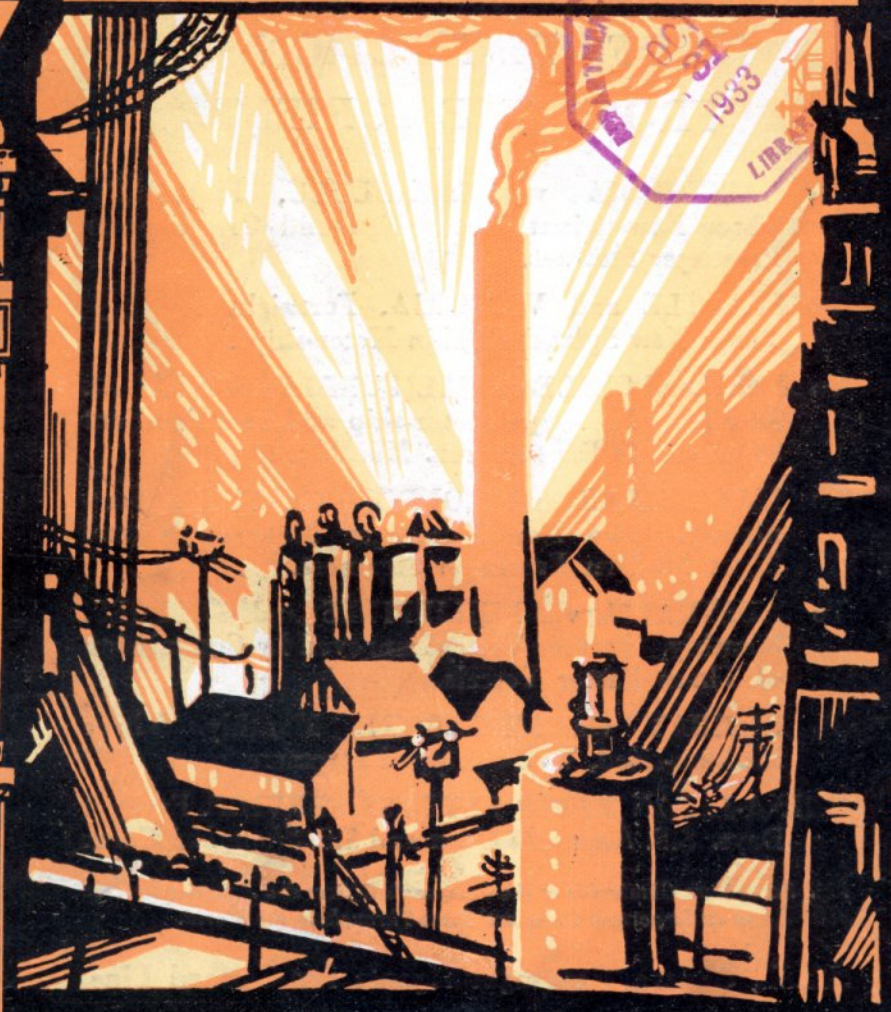


上海黃浦灘念四號

遠東時報

TREATY STATUS OF MANCHURIA

MATSUOKA'S FINAL WORD

REALITIES IN THE FAR EAST

RUSSIA IN THE METAL WORLD

Vol. XXIX | MARCH, 1933 | No. 3

With regard to the steel imported by Russia, this could have been produced in Russia if the program for production had been realized, except perhaps certain "quality" steels in the manufacture of which the Russian industry has not yet been very successful. The production plans in regard to aluminium are on an equally ambitious scale and production was started last year in a plant with a capacity to cover recent consumption of aluminium in Russia. The production of aluminium, however, is a highly technical affair, and it would not be surprising to learn of early troubles in these Russian attempts at production. The Russian bauxite used for the production of aluminium is not of high grade, and various schemes for preparing it for reduction, of a novel character, have yet to be fully proved. The production of copper, lead and zinc in large quantities is merely a question of developing the industries on a basis of the sufficiently abundant ores of the same available in Russia and Siberia. Assuming the second Five Year Plan proceeds without internal or external interruption, it seems safe to conclude that at the end of that period, Russia will be in a position of independence as regards these metals. In some Continental circles connected with the metal markets, it is evidently believed that Russia will be a large exporter of non-ferrous metals in the not very distant future.

Against this view, besides the low efficiency referred to, there must be taken into consideration the very small present metal consumption per head of the population of Russia, and the potential enormous great increase; this applies not only to metals, but to petroleum, which is becoming one of the main exports of Russia. With any considerable economic improvement in Russia, and in the standard of living, a population of round 150 million souls could easily absorb the proposed increased production of metals.

In considering the Russian position, it is necessary to visualize an economic system which is unique in the world. The present necessity to export Russian products is mainly to balance the extensive imports of machinery and equipment in connexion with the industrialization plan. As this plan progresses, it must be assumed that such machinery and other material now imported, will be made in Russia itself in an ever-increasing degree, and that Russia is on the way to become gradually more and more self-contained. It is maintained by the Soviet that the increasing industrial capacity will then be employed in ministering to the wants of the Russian people and not, as many think, in glutting the world's markets at dumping prices.

With the present necessity to export, Russia suffers like all other exporting countries, from shrunken world markets and abnormally low prices. Figures from a German source show that last year, while Russian exports increased quantitatively, the value was much smaller than that of the smaller quantity of exports in 1931. The strenuous efforts of the Soviet authorities to widen their export trade by price cutting appear to have brought no increase in revenue from the exported products. In 1929 the Russian trade balance was favorable to the extent of 43.1 million roubles; in 1930, the balance was an adverse one to the extent of 22.4 million roubles, and in 1931 to the extent of 293.8 million roubles. The 1932 figures are not yet available, but it is understood that the conditions were similar to those in 1931.

Hitherto, the Soviet Government has apparently been able to meet all obligations for material supplied from abroad on long term credit, but with the growth of the adverse trade balance, some of Russia's creditors are said to be becoming nervous as to future payments. In any case, this position must tend to the restriction of credit, and the supply of materials to Russia on long term credits. This may well slow down, if not shatter, the program for the second Five Year Plan, including the large-scale metal producing plans.

One of the greatest hindrances to the industrialization of Russia and the development of the mining and metallurgical industries is the lack of technical direction and labor. Strenuous efforts are being made by the authorities to overcome this difficulty by establishing technical training institutes to train a personnel. As to the success being obtained in this direction, the reports are conflicting; on the one hand, it is maintained that the students eagerly and quickly assimilated the instruction given, but on the other hand, it is stated that lack of discipline and irregular attendance on the part of the students are characteristic of such institutes. Unless a fair amount of success is obtained in these training efforts, the chances for a realization of the industrialization plans must be very precarious.

Tanna Tunnel Nears Completion

Only 1,400 feet remain to be pierced in the Tanna tunnel construction. After many years of the most difficult engineering feats, the completion of the tunnel by this summer is now in the realm of possibility.

Every day, laborers are drilling into the rock many feet underground, moving forward two feet daily from the eastern portal and from five to six at the western. The infiltration of subsoil water has been controlled and victory is only a question of time.

The Railway authorities who have been carrying on the plan of shortening the Tokaido line, cutting out the Hakone Bend by means of the tunnel, are at last feeling at ease. Even with the most unexpected and difficult developments taken into consideration, the middle of August is the latest date set by them for the project's completion. If things move smoothly, the bore will be blasted through as early as the end of June.

One serious problem in connection with the construction of what will become the longest railway tunnel in Japan, has been the drying up of streams and wells in the region affected.

The underground waters, making their escape into the tunnel, have drained wells and ponds, causing great inconvenience to the farmers living in the land above the tunnel.

Since 1926, the Railway authorities have given from Y.20,000 to Y.40,000 in grants to the farmers, but in order to settle the problem once and for all, they have decided to expend Y.600,000 for relief measures.

In co-operation with the Shizuoka railway authorities, they have completed a plan for satisfying the protesting farmers.

The money will be spent in the following ways:

1. Transforming paddy fields into dry farms.
2. Bringing part of the water supply of the region by an aqueduct from the Karino River.
3. Building storage ponds in appropriate locations.
4. Supplying water by pumps where reservoirs cannot be constructed.
5. Using the water issuing from the drainage tunnel of the Tanna project for the irrigation of lower lands.

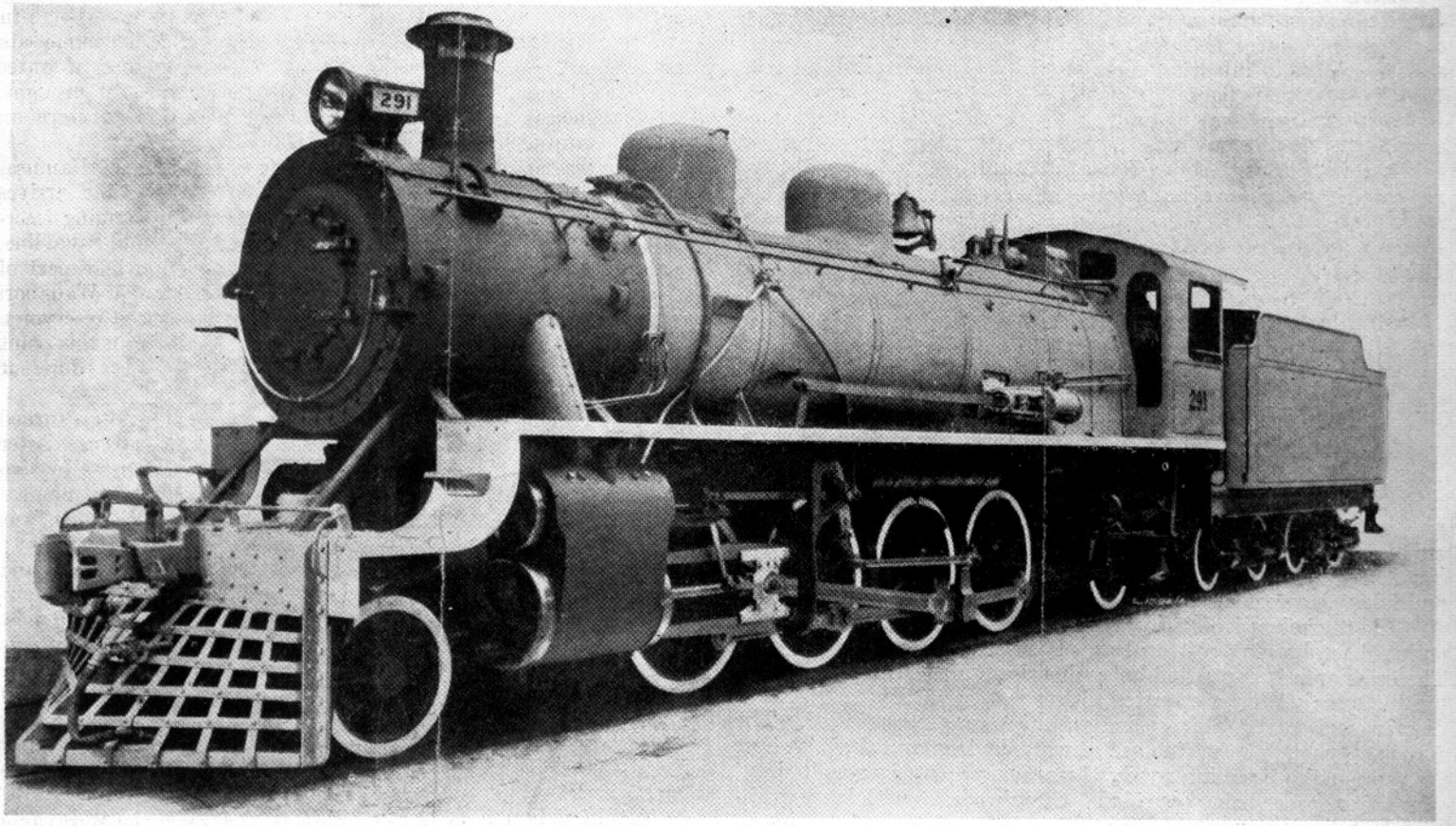
Attention has also be directed by the authorities to the rearrangement of the schedule of the Tokaido line, in view of the nearing completion of the tunnel. The question of the dwindling traffic on the Hakone Bend section of the present line is also taxing their brains.

New Canton Bridges

While the gigantic bridge across the Pearl River joining the Honam Island to Canton City proper is now in its final stages of building the Canton municipal authorities are stated to be contemplating the building of another bridge linking up the parts of the city, but crossing the river from the West Bund, in the vicinity of the wharf for the steamers of the Hongkong-Canton-Macao Steamboat Company, one of the most busy commercial centers of Canton city.

The Public Works Department is said to have received instructions for sounding the river bed on the proposed site for the new bridge, to see if the scheme is practicable. Large though the bridge now nearing completion is, it is felt that it alone is not adequate to meet the increasing volume of cross river traffic, more particularly when the construction of the inland port on the western part of Honam is completed. The proposed new bridge crosses the river at a point much nearer to the said inland port locality.

In this connection, it may be noted that another bridge is under consideration crossing the Pearl River further west of the city, and joining Canton to Fati. This bridge, which is to be built jointly by the Canton Municipality and the Canton-Hankow Railway Administration, has already passed its initial planning stage, and in fact a provisional contract has already been awarded to Messrs. McDonnell and Gorman, the same contractors who are building the bridge now almost finished.



Notable New Locomotives for China*

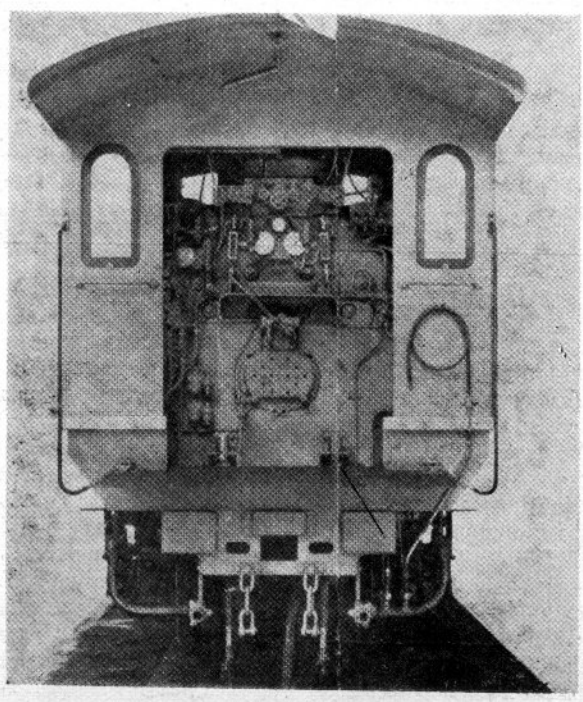
Eight interesting engines constructed by Nasmyth Wilson & Co., Ltd., for service on the Chinese Government Railways

A CONTRACT for eight 2-8-2 type heavy mixed traffic locomotives for service on the 4-ft. 8½-in. gauge is just being completed at the works of Nasmyth Wilson & Co., Ltd., Patricroft, Manchester. They were shipped, fully erected, from Manchester on Wednesday, December 14, special arrangements having been made for their transit over the L.M.S.R. to the Manchester Docks which, owing to their being out of load gauge, involved a slewing of tracks and also a lowering of the rail level at several points.

The engines have been constructed to the order of the Chinese Government Purchasing Commission for the Ministry of Railways, China, out of the China Indemnity Fund, or, as it is sometimes called, the Boxer Indemnity, the Consulting and Inspecting Engineers being Messrs. Sandberg, of Grosvenor Gardens, London, S.W.1.

Locomotives of this description have been supplied to China in the past by American locomotive building firms and in the construction of this new series American drawings have been primarily worked to. A condition of the contract was that the dynamic augments at 45 m.p.h. must not exceed 15 per cent of the static load of any one pair of coupled wheels.

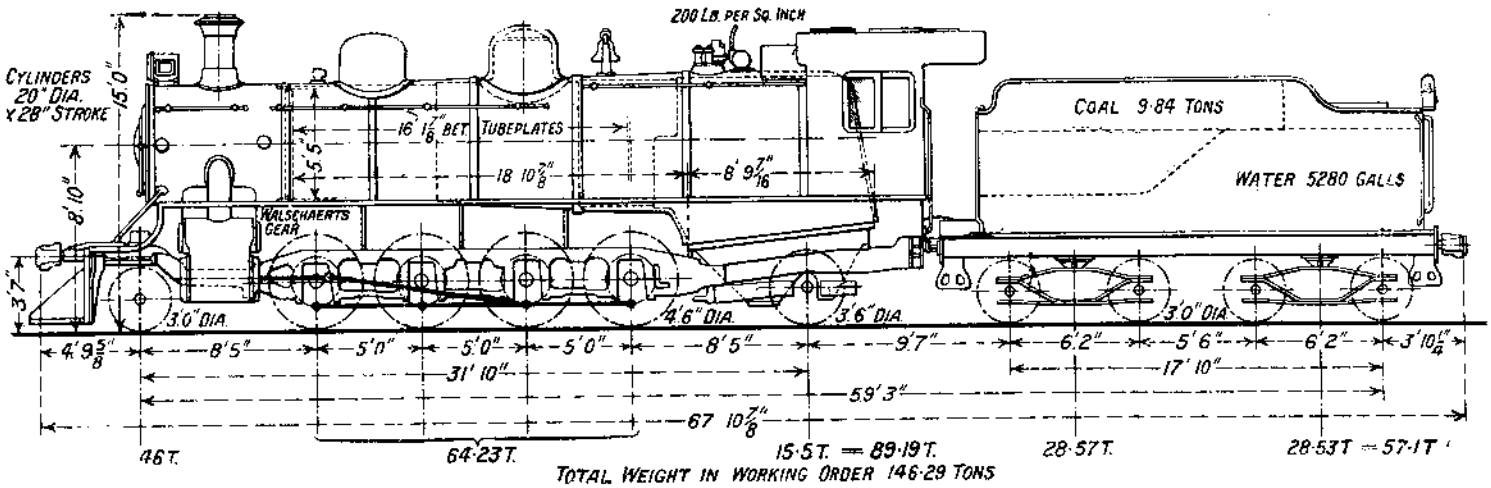
The engines are of large size and the equipment is very complete. They have bar frames cut from solid forged steel, the thickness being 4-in. The cylinders, as the photograph and drawing show, are placed outside the frames and drive the third pair of coupled wheels. Steam distribution is effected by 11-in. diameter inside admission piston valves. Walschaerts valve gear being employed. The cylinders are cast integrally with the valve chests and smokebox saddle, the cylinder barrels and valve chests being fitted with liners. Automatic steam-operated cylinder drain cocks and British made, crescent-type metallic packing are fitted. The drifting valve is provided with connections to the cylinders and water relief valves are placed on the cylinder covers. The reversing gear is of the single cylinder power type, air or steam operated. The driving wheels are fitted with bronze hub liners and the axleboxes are of cast steel with bronze bearings and the axlebox guides have adjustable wedges. The coupled-wheel springs, placed above the axleboxes are compensated. The crank pins and piston rods are made of carbon-vanadium steel. The leading truck is of the swing link type and the hind truck of the radial arm type. Air valves are mounted on the steam chest.



View of Locomotive Cab

The boiler, the center line of which is 8-ft. 10-in. above rail level, has a diameter next the smokebox of 5-ft. 5-in. inside and a length between tube plates of 16-ft. 1⅞-in. The section of the barrel next the firebox is tapered and the firebox itself is fitted with a combustion chamber. The boiler is of steel throughout and carries a working pressure of 200 lb. per sq. in. The tubes

* *The Railway Gazette.*



Dimensional Drawing of the Locomotive

are of solid drawn steel and the superheater is of the M.L.S. pattern supplied by the Superheater Co., Ltd., having the header and multiple valve regulator combined.

The smokebox is fitted with a spark arrester. The firebox is designed for burning soft coal and is fitted with a rocking grate. The brick arch is supported on arch tubes and the fire door is of the "Butterfly" type operated either pneumatically or by hand. Ashpan and coal water sprinkler injectors are provided. The firebox staybolts at the side are of wrought iron and flexible stays are used in the breaking zones, these being also of wrought iron, 4-in. water spaces being provided. Cleaning holes with large washout plugs having screwed caps and two blow-off cocks figure in the equipment, as does also a steam turret having separate chambers for saturated and superheated steam. There are three pop safety valves and near them is located a five-chamber chime whistle. The boiler is fed by two non-lifting injectors delivering into a top feed clackbox placed at the front end near the smokebox.

A dual pressure gauge with connections to the cylinder exhaust and steam passages is mounted alongside the boiler pressure gauge, together with steam heating pressure gauge above them. A steam boiler tube cleaner figures in another item in the equipment. A five-feed sight feed lubricator with connections to the cylinder barrel, steam pipes and Westinghouse pump, is located in the cab and every provision has been made for the comfort and convenience of the enginemen. The cab is provided with doors in the front and windows at the back and sides. It is lined with teak and has upholstered seats with arm rests and sliding side windows. The regulator and other controls are arranged within easy reach of the driver. The roof of the cab is extended well back over the footplate and affords every protection to the fireman when shovelling coal.

Other items of equipment are central standard type "D" automatic couplers with American type friction draft gear and two-key attachment, electric head lights and cab lights; bell with automatic air ringer: steam heating for the train, asbestos mattresses on the boiler, firebox and cylinders, Westinghouse air brake, cross-compound pump, and a water level indicator on the tender tank.

The following are the principal dimensions:—

Cylinders (2)—	
Diameter	20-in.
Piston stroke	28-in.
Wheels—	
Coupled, diameter	4-ft. 6-in.
Leading truck, diameter	3-ft. 0-in.
Trailing truck, diameter	3-ft. 6-in.
Wheelbase—	
Rigid	15-ft. 0-in.
Total (engine)	31-ft. 10-in.
Boiler working pressure	200 lb. per sq. in.
Heating surface—	
Tubes	1,722 sq. ft.
Arch tubes	23 sq. ft.
Firebox	200 sq. ft.
Total	1,945 sq. ft.
Superheater	443 sq. ft.
	2,388 sq. ft.
Grate area	43.5 sq. ft.

The total weight of engine and tender in working order is 146.29 tons, distributed as shown on the outline drawing. The engine develops a tractive effort, at 85 per cent of the boiler pressure, of 35,259 lb. The tender is carried upon two diamond framed four-wheeled bogies; it has a fuel capacity of 443 cu. ft. and a water capacity of 5,280 gallons.

The locomotives are intended for service on the Tientsin-Pukow Railway on which maximum grades of 1 in 100 are encountered. The sharpest curve on the main line is 980-ft. radius and of 600-ft. radius in the yards.

The engines are painted black with red lining and present a very well finished appearance, which is enhanced by the copper capped chimneys.

Activities in Manchukuo

As practical measures for the maintenance of law and order in Manchuria have been mapped out, the Manchukuo authorities havedecided to launch the gigantic task of developing various industries in the new State in co-operation with the Japanese.

First, the government has undertaken to complete the webs of communications, building railways and motor-roads to facilitate the development of the countryside and maintain peace and order. As reported, the government has decided to inaugurate the Manchukuo Aero-Transportation Co. to connect Europe and the East by air. Secondly, the authorities plan to establish a communications concern and will undertake to connect Japanese telephone lines with the Chinese lines at Mukden and Changchun. Thirdly, a Japan-Manchukuo concern will be established for the development of the mines of gold, iron and coal. At the same time, the Japanese have definitely decided to open factories for the manufacture of crude oil and sulphate of ammonia and inaugurate the Showa Iron Works. Fourthly, a scheme for the establishment of aluminium and magnesium plants is afoot as a Japan-Manchukuo joint concern.

Fifthly, the authorities of the Overseas Affairs Ministry of Tokyo have decided to send the first group of some 500 immigrants to Manchukuo for the agricultural development of the new State, and accordingly, it is optimistically expected that Manchukuo will be turned, in due course of time, into the "land of promise," when the entire land is fully developed.

As to raising funds necessary for these projects the Japanese Military authorities are considering practical measures. It is reported in this connection that the authorities intend to organize a capital pool with funds raised extensively by the Japanese of middle and lower classes in order to avoid control by any group of capitalists.

Engineering Notes

INDUSTRIAL

BAUXITE FOR JAPAN.—According to reports from Holland, good progress is being made in connection with the negotiations for the establishment of a bauxite industry on the island of Bintam, in the Dutch East Indies. It is hoped to find a market in Japan, where a scheme is on foot for the establishment of an aluminium industry with the support of the State. The Japanese import about 10,000 tons of aluminium from the United States per annum, but it is desired to become independent of this source.—*Electrical Review.*

PROJECTS IN MANCHUKUO.—Plans for new industries have received formal approval of the South Manchuria Railway Company. First is the foundation of an aluminium industry, which has been under discussion for two years. Factories are to be started at Mukden or Fushun before the end of the year. The cost of the project will be about Y.10,000,000. The directors on September 20, also made final decision with regard to ammonium sulphate, and a company with a Y.25,000,000 capitalization will be incorporated shortly. Work will be started in April, and will be completed in two years. According to the plan, the annual output of ammoniates will be 170,000 tons.

CANTON IMPROVEMENTS.—Preparations are under way for carrying out of the Greater Canton project providing for new elaborate road and drainage systems. Plans approved by the Municipal Government, to be carried out at once, give the city new commercial, agricultural, residential and amusement areas. The projects also calls for the construction of new tramway lines, aerodromes, railway stations and maloos. Considerable interest is being drawn to the tramway project. Despite its large size Canton is without a tram service. A tramway covering many of the principal thoroughfares was laid over ten years ago, but on account of a dispute between the company and the government, the service has never been inaugurated.

RATIONALIZATION IN JAPAN.—Schemes for the rationalization of practically every branch of industry in Japan are reported. One proposal affecting the electrical machinery market concerns the control of the Shibaura, Fusi, Mitsubishi and Hitachi Works, while another scheme relates to the Japan Electric, the Oki Electric, and the Adachi Electric Machine Companies. Upon the advice of the commercial and industrial authorities the Tokyo Electric Lamp Industrial Guild is taking steps to control the electric lamp industry, and various schemes of co-ordination are being drawn up. The establishment of a national federation of electric lamp manufacturers is considered probable, but it is possible that a national sales company may be formed.—*Electrical Review.*

SHANGHAI EXPANSION.—The Nanking Ministry of Railways is planning to construct short branch lines in Greater Shanghai for the development of the municipal area. An order to the Nanking-Shanghai and Shanghai-Hangchow Administration instructs that survey operations be started immediately and an estimate of cost prepared for the construction of feeder lines linking Chenju and Jessfield; Chenju and Kiangwan; and Kiangwan station and Jukong village on the bank of the Whangpoo River area.

To expedite the construction of the new railway station at Shanghai which is to take the place of the North Station bombed by Japanese aeroplanes during the Sino-Japanese hostilities, officials of the Ministry of Railways have consulted with the Municipal Authorities regarding the expropriation of land. As construction work on the new station at Chenju would take some time, a temporary station will be built on railway property near the Sung Chiao-jen Gardens in Chapei.

RAILWAYS

TRAMS FOR NANKING.—Three routes have been mapped out by the Reconstruction Commission as the beginning of a tramway system for Nanking. The routes will traverse the busiest sections of the city. The tram lines will be laid down in three stages at a cost of approximately 13 million dollars. The Reconstruction Commission of Nanking has addressed a communication to the Trustees in charge of the British Boxer Indemnity Refund requesting a loan of $3,000,000 for the project.

RAILWAY WORK IN CHINA.—Completion of the entire Canton-Hankow Railway within three years, instead of eleven years, as would be required under present arrangements with the Trustees of the British Boxer Indemnity Refund, is under consideration by the Chinese Ministry of Railways. It is learnt that the Ministry is planning to raise the sum of over $30 million necessary for the project by pledging the eleven annual instalments from the British Boxer Indemnity Refund as security for a loan.

LUNG-HAI LINE OUTLET.—With the new harbor at Hsukow, on the Kiangsu coast of China, nearing completion, the Managing-Director of the Lung-hai Railway, is calling for the development of traffic. To facilitate the transfer of freight from the railway to steamships, the Railway Administration has undertaken the development of Hsukow as a harbor, and has constructed an extension of the line from Haichow. The Asiatic Petroleum Company has despatched representatives to Hsukow to investigate possibilities. The eastern extension of the Lunghai Railway will be completed by next spring.

SHIPPING

SHIPPING MERGER.—Keen attention in Japanese Business circles is being centered on the current rumor concerning the amalgamation of two of the leading steamship Companies in Japan, the Nippon Yusen Kaisha and the Osaka Shosen Kaisha. The high authorities of both companies have been in conference discussing concrete measures for such an amalgamation.

BUYING FORMER CUNARDER.—A Japanese firm is stated to be negotiating for the purchase of the former Cunard steamer *Caronia*. The vessel was bought by Messrs. Hughes, Bolckow, ship-breakers, of Blyth, at the beginning of the year. Workmen are now preparing the ship for tests, and the purchase will be dependent on the boilers being found to be in a good state.—*Yorkshire Post.*

CHINESE SHIPPING SERVICES. Plans for the establishment of new shipping lines are under consideration by the management of the China Merchants Steam Navigation Co. The Shanghai-Haichow service will be resumed shortly. During the régime of the late Mr. Chao Ti-chao the Company, under agreement with the Lung-Hai Railway, maintained a regular freight service to Haichow, which proved to be very profitable, but this service was suspended by his successors. In compliance with requests from the Lung-Hai Railway, it is planned to resume the service immediately in order to meet a keenly felt need. It is understood that the present management has also decided to charter two 3,000 ton vessels for resumption of the service to Amoy, Swatow and Canton. As a result of the boycott against Japanese shipping, foreign shipping companies having regular services to the Southern ports have been doing exceedingly well and cargo has frequently been shutout. Althought he China Merchants had regular sailings to these Southern ports in past years, the service was suspended owing to shortage of seaworthy vessels. It is also understood that the Company is planning a special express service between Shanghai and Hankow.

CHINESE SHIPPING INSPECTION.—Immediate enforcement by the various Chinese Navigation Bureaux of regulations governing the measurement and examination of shipping, already promulgated by the National Government, is ordered by the Ministry of Communications. All steamers owned or chartered by Chinese citizens for navigation in Chinese waters, or between China and foreign countries, as well as foreign-owned vessels operating between Chinese ports according to law or by special permission of the Chinese Government, are subject to these regulations. All other foreign-owned vessels which do not fall under the above category but are subject to the stipulations of Article XV of the Shipping Law are to be similarly measured and examined by the Navigation Bureaux.

COMMUNICATIONS

TOKYO-SEOUL 'PHONE SERVICE.—The Tokyo Department of Communications plans to open direct telephone service between Tokyo and Seoul, Korea, shortly. One of six cable lines connecting Shimonoseki and Fusan will be used.

WIRELESS TO NANKING.—In order to handle the increasing traffic on the Nanking-Shanghai long-distance telephone line, the Ministry of Communications has decided to instal radio telephone facilities to augment the present service.

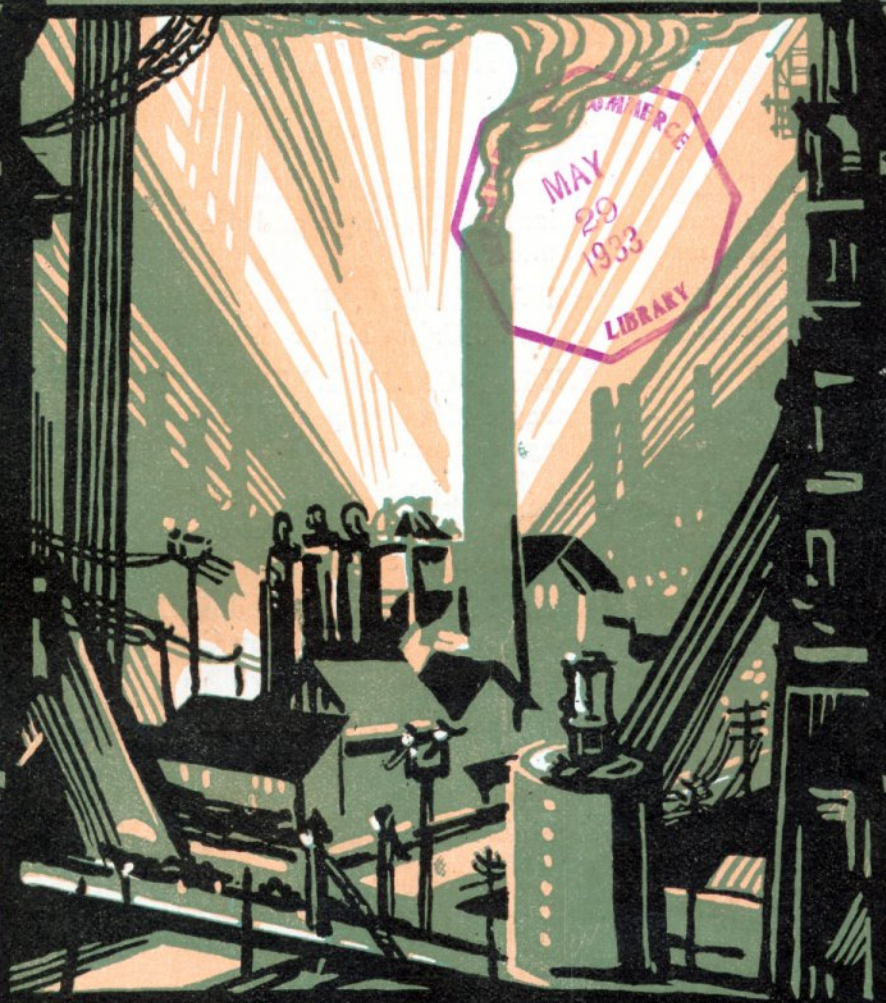
WIRELESS TO GERMANY.—Long-distance radio telephony between Shanghai and Berlin will shortly become a reality, it is reported. Replying to a communication from the German Government, the Ministry of Communications has agreed to the proposal for the introduction of radio telephonic communication between the two countries. Experiments will be carried out as soon as installation of the apparatus is completed.—*Kuo Min.*

NEW 'PHONE LINES.—Satisfactory progress is being made in the erection of the two additional lines for the Nanking-Shanghai long-distance telephone service. Wires have been put up as far as Soochow from Shanghai and as far as Chinkiang from Nanking, the entire lines to be completed and open to traffic by New Year's Day. The installation of these lines was ordered by the Ministry of Communications in order to cope with the increase of traffic.—*Kuo Min.*

NEW WIRELESS SERVICE.—Already in contact with most of the world, the Chinese Government Radio Administration announces that it is negotiating with Russia for establishment of wireless communication with the Soviet—a result of the recent resumption of diplomatic relations between the two nations. Several points of contact are being sought which will include services from Moscow, Vladivostok and other leading Russian cities with Shanghai. The Minister of Communications announces that traffic will be started very soon.

CHINESE HIGHWAYS.—The Chinese National Economic Council has agreed to appropriate $200,000 immediately towards the construction of important highways for border defence in the provinces of Honan, Hupeh, Hunan, Anhwei, Kiangsi, Kiangsu and Chekiang. Mr. Chen Ti-cheng, newly appointed Director of the Border Defence Highways Bureau for these seven provinces, who was until recently Director of the Provincial Highway Administration for Chekiang, applied to the National Economic Council for a subvention of a million dollars. As a result of personal negotiations at the Capital, it is understood that the Council has agreed to appropriate immediately one-fifth of the required sum, the balance to be available when subsequent progress is reported.

THE FAR EASTERN REVIEW



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遠東時報

THE RED SCOURGE IN CHINA

THE ROAD TO NATIONAL SALVATION

INTERNATIONAL BACKGROUNDS

SAY IT IN CHINESE

Vol. XXIX | APRIL, 1933 | No. 4

at a constant displacement of 3,730 tons, the relations between speed and power are as follows :—

	s.s. Aniwa Maru	*s.s. Soya Maru*	*Diff.*
Displacement, tons ..	3,730	3,730	0
Draught, ft. and in. ..	16′–2″	15′–3¼″	10¾″
Horse-Power, at 9 knots	700	700	0
,, ,, ,, 11 knots	1,520	1,100	420
,, ,, ,, 16 knots	5,520	3,850	1,670
At a constant draught of 18-ft.			
Displacement, tons ..	4,358	4,642	284
Horse-power at 11½ knots	1,965	1,415	550

Therefore, 550 h.p. per hour is saved in the *Soya Maru* which makes a saving of 4,400 h.p. at eight hours of the usual navigation in summer. Thus, the improvement in this line may be considered very remarkable.

HEATING AND VENTILATION.—As described already, very considerable improvements have been carried out in the *Soya Maru*.

THIRD CLASS PASSENGERS' ACCOMMODATION.—Owing to the democratic tendency of general passengers, special improvements will be perceived in this vessel for the comfort and convenience of this very popular class of passengers.

Chain Cable and Anchor Testing Machine Has Capacity 750 Tons

(Continued from page 180)

which runs on rollers provided with ball bearings. This poise, the travel of which is 200 inches, is made in two portions, the combined weight being two tons. As the machine has been specifically designed to avoid the use of proportional weights suspended from the end of the steelyard, it will readily be appreciated that the total leverage of the machine is 375 to 1. A vernier is fitted to the minor portion of the poise and this indicates the test load upon a scale plate secured by brackets to the steelyard. The same vernier is utilized when the combined poises are used.

The scale plate carries two sets of graduations, the major set, used with the full poise weight, is up to 750 tons by 10 cwt. divisions, but by means of the vernier fitted to the poise, load readings to 1 cwt. are obtained. The minor set of markings used with the minor poise range up to 150 tons by 2 cwt. divisions, the vernier further sub-dividing to 28 lb.

When the minor poise is used, the major portion is locked in position at the back end of the steelyard. The minor portion is detached by the simple operation of two handwheels at the end of the small poise.

A propelling nut of the split variety secured in the minor portion of the poise is provided so that any adjustment necessary on account of wear may readily be made.

The actual propulsion of the poise is carried out by means of the handwheel at the side of the standard supporting the steelyard. It operates a horizontal shaft which, through bevel gears at the back of the standard, transmits the drive, via layshafts and spur gearing to the poise-propelling screw carried on ball bearings in the center of the steelyard and extending from one end to the other. This arrangement of poise drive permits an uninterrupted view of the steelyard scale plate throughout the test.

A flotation pointer, arranged immediately above the handwheel for propelling the poise, readily indicates to the operator the balance of the steelyard.

To absorb shock to the steelyard when a specimen breaks, buffer springs are provided on a carrier column at the long end of the steelyard. It is at the main levers and links, however, where the main recoil shock occurs, and special provision has been made to receive this by a heavy casting directly opposite each main lever and its link. This casting is provided with special hard wooden blocks so adjusted that immediately a break occurs, the recoil is taken up and dissipated.

As the machine with its standard shackles is capable of testing specimens of any length from 3-ft. to 100-ft., leaving available the stroke of the ram, it will be readily understood that the machine can be used for both proving and breaking samples of chain cable, in addition to testing anchors ; whilst by the use of suitable holders samples of wire ropes and a variety of specimens can be tested. The machine, although of such a high capacity, is capable of recording loads by increments of 28 lb. It is thus a very useful addition to the testing equipment of the country, and the co-operation of Mr. George Hatton, C.E., and of Mr. Henry Green, M.I.M.E. has helped to ensure that the machine is particularly suitable for the special purpose for which it is required.

The construction of this machine completes a trio of special high capacity testing machines built by W. & T. Avery, Ltd., in recent years. The first was the Universal Testing machine of 1,250 tons capacity used in connection with the construction of the Sydney Harbor Bridge, while the second was the 1,000,000 lb. Vertical type testing machine made for the Department of Mines, Ontario.

Notable Malaya Plant Supplying Pure Water From Polluted Source

(Continued from page 178)

always a 100 per cent product, so that the dose of chlorine can be regulated with the greatest accuracy, quite different from the use of unstable bleaching powder or hypochlorites.

The results of this plant are highly satisfactory and the average method of operation consists in the use of approximately 0.5 parts of chlorine per 1,000,000 parts of water, along with one grain per gallon of sulphate of alumina and of lime, but varied of course according to the circumstances. In most areas of the world it is generally not necessary to use more than about one part of chlorine per 1,000,000 parts of water, and in this Alor Star scheme, for example, the purified water has no Bacteria coli in 100 c.cs, the standard test for bacteriologically pure water. The raw water however, as already indicated, is very bad, showing Bacteria coli in only 0.01 c.cs, corresponding to 500-600 colonies of bacterial growths in 1 c.c. on Agar plates at 37° C. in 24 hours.

The Canton-Hankow Railway

Four years have been set as the goal for completion of the 700 mile long Canton-Haukow Railway, the Ministry of Railways announces. This will be occupied in bridging the gap between Chinchow, in Kuantung Province, and Chuchow, in Hunan.

The Ministry also revealed that discussion has been re-opened for constructing the projected Nanking-Hunan Railway, cutting across the middle south from the national capital to Changsha, a venture estimated in 1914 to involve an expenditure of $400,000,000.

The Canton-Hankow Railway, which will connect two of the nation's greatest centers of trade, is now two-thirds completed. One section is known as the Siang Yueh railway and the other as the Hunan-Hopeh line.

Surveying has now begun, impetus to the fresh start having been given by a loan of £1,500,000 with the British Boxer Indemnity Fund as security. Mr. Ling Hang-shung, who built many stretches of the Lunghai Railway, left this city a few days ago to take charge of the work. British interests will supply the material.

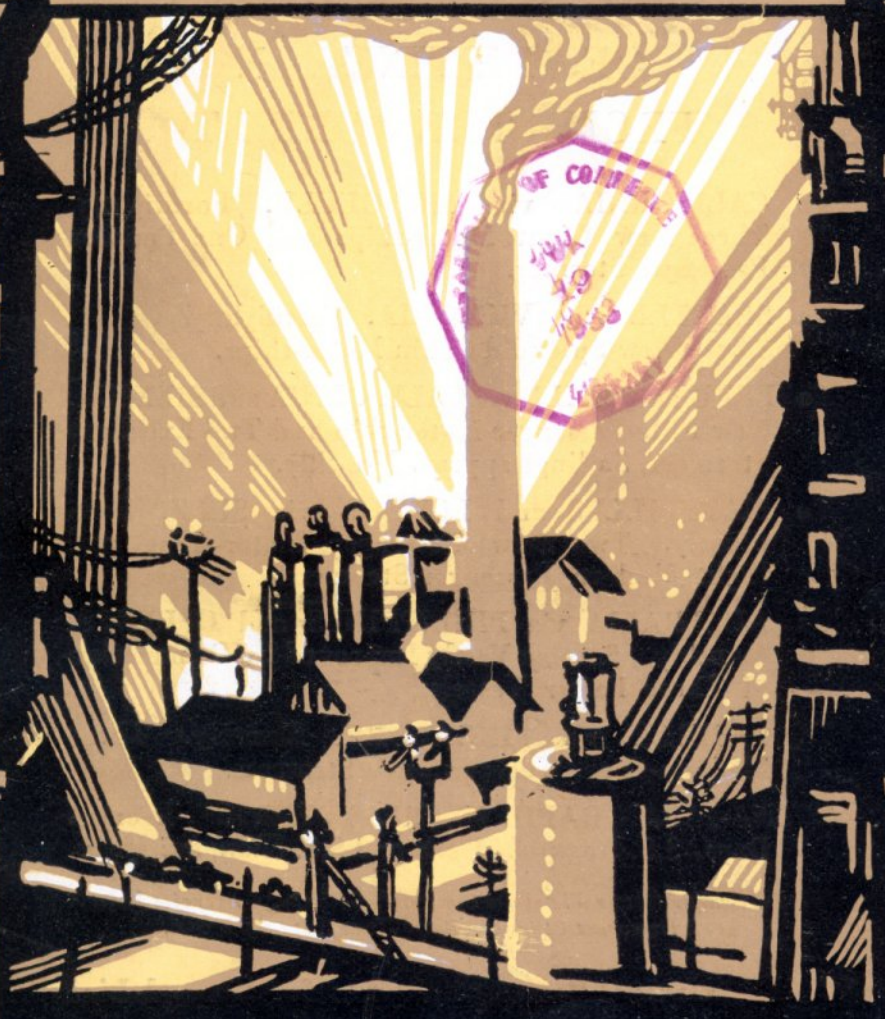
That the time estimate has been placed at four years is due, say Ministry officials, to the mountainous country that must be traversed. Much of the road will have to be blasted.

The projected Nanking-Hunan Railway, for which a contract made with British interests in 1914 is still valid though revision will be necessary, will be slightly shorter than the north-south line and will follow the course of Yangtze River in most part.

Interest in it has been revived by the application by a group of Chinese for permission to construct a line through Wuhu. It is a small venture and would represent an outlay of approximately $1,000,000. Its primary purpose would be to bring rice from the Wuhu country to the river.

Being in the neighborhood of Changsha, the line would necessarily follow the course plotted for the Nanking-Hunan roadbed. One factor is holding up the granting of permission. The small line will be of narrow-guage and its equipment as well as roadbed will be practically useless later for amalgamation purposes when the through line is built.

THE FAR EASTERN REVIEW



THE FALLACY OF THE LYTTON REPORT

FACTS ABOUT MANCHUKUO

THE TANNA TUNNEL

Vol. XXIX | MAY, 1933 | No. 5

上海黃浦灘念四號

遠東時報

Railway Construction Pushed by Manchukuo*

Taian-Koshan-Tungpei-Hailun Line and Link Between Tunhua and Korea to be Ready for Operation in Time to Handle Autumn Crops

By CHOKIURO KADONO, Vice-President, Okura & Company

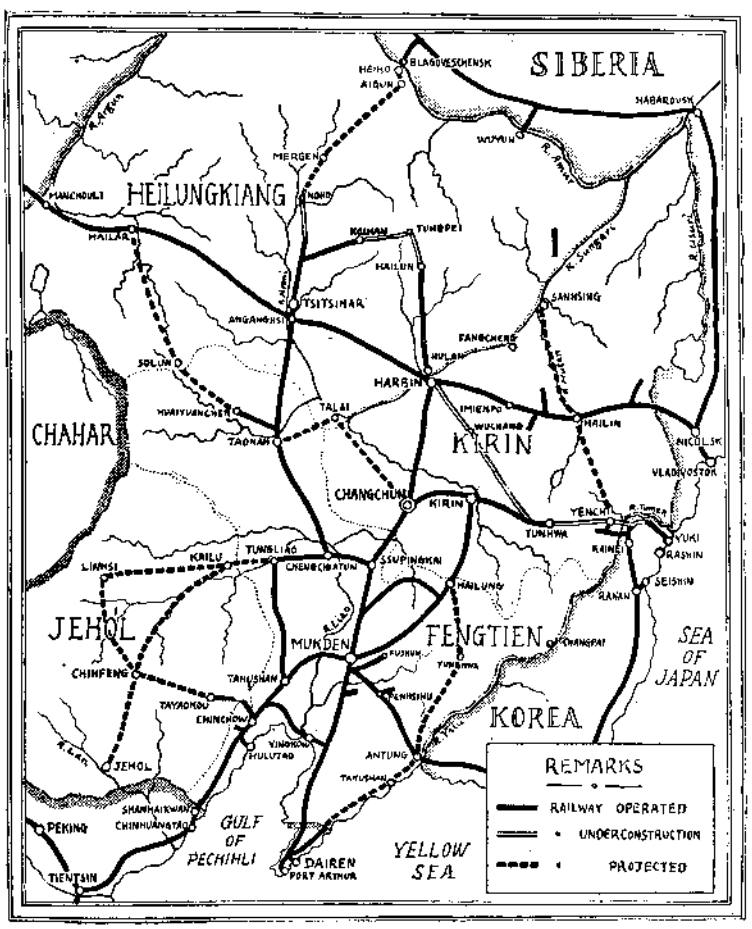
RAILWAY progress in Manchuria, already much more notable than that of China, is continuing. Last year new construction was pushed forward and much of what was undertaken will see completion in 1933. Again, all state lines taken over from the old régime were placed under the control of the Manchukuo Central Railway Bureau, with head office at Mukden, and the management of the South Manchuria Railway.

Perhaps the most important railway development this year will be the opening to traffic of the Changchun-Kirin-Tunhua-Yuki line, which will serve as an artery for the flow of produce and passengers between northern Manchukuo and the Japan Sea. The northern section of Manchukuo cannot be compared with the south. It is incomparably better in both quality of soil and abundance of water. There is no richer valley in the world than the water shed of the great Nonni River, which will be tapped both by the Chinese Eastern Railway and the State lines leading to the Japan Sea. It will be an interesting study to watch the growth of this part of the Asiatic continent with the energetic assistance of Japan.

Railway construction between April, 1932, and April, 1933, was fairly active in North Manchuria. Work progressed on lines connecting the cities of Taian, Koshan, Tungpei and Hailun, about 150 miles in all. This link has been practically completed and may be in operation by the summer. A line branching off from Ningnien on the Tsitsihar-Taian road, some 25 miles in length, is graded and may be open for traffic at the same time. These 175 miles are the sum total of new railway construction in north-western Manchuria.

But the 120 mile strip connecting Tunhua with the Korean border will be ready by the summer, in time to handle the heavy crop movements of the fall.

Some work has been done on the line between Harbin and Tunhua by way of Wuchang during the past year but only a little progress has been made, due to the heavy nature of the country.



The Railways of Manchukuo

May Build in Jehol

So far there is no definite indication which of the other projected lines will be taken up during the coming season. But it is natural that, after the events in Jehol of the past few months, some railway construction there will be undertaken. Whether the building will be westward from Tungliao on the Chengchiatun-Tung-liao-Takushan line or whether there will be an extension of the Chinchow-Peipiao line into the heart of the province so far has not been announced. It may be that both will be undertaken, although building will consume much more time than a year or two.

In Manchuria only half a year, from April to October, is fit for outdoor building work. This inclement climate retards the speed of construction by 50 per cent when compared with milder climates such as Japan. This is also the case in house building. Changchun, the new capital, has been unable to house its increasing population, as no building work can be attempted from late autumn to late spring.

There will no doubt be great building activity in the new capital during the summer, as great preparations have been made and the required materials have been accumulated during the off months.

The most interesting event in the Manchurian railway world has been the establishment of central management for the Manchukuo State Railways. Management is in the hands of the South Manchuria Railway, under the supervision of the Manchukuo Government. These state lines cover 2,150 miles which originally were under eight different managements, nominally more or less controlled by a central authority but actually each and all pulling in different directions.

This has all been changed and a central and single authority called the General Railway Bureau has been opened in Mukden with Mr. Usami as its chief to operate and manage all the state-owned lines. This bureau will co-operate with the South Manchuria Railway in all important operating and tariff arrangements. The state-owned lines occupy a most imposing position. In length they cover three times the length of the South Manchuria Railway lines. The two systems can co-operate and complement each other.

International Connections

The third system is the Chinese Eastern Railway (now called the North Manchuria Railway). Taken together, the three systems have important international connections. The most important of these are:

(1) Dairen-Harbin-Manchuli, to connect with Trans-Siberian trains for U.S.S.R. and Western Europe.

(2) Korean-Antung-Mukden, to connect with the South Manchuria main line at Mukden.

(3) Yuki (Rashin), Korea-Tunhua-Kirin, to connect with the South Manchuria Railway main line at Changchun.

(4) Mukden-Shanhaikwan, to connect with the Chinese Government Railways for Tientsin and Peiping.

(5) Vladivostok-Harbin-Manchuli and Europe.

These are the lines which are of importance because of international connections. With these main thoroughfares and with the seaports of Dairen and Yuki (Rashin) in view, the flow of

(Continued on page 239).

* *Japan Advertiser Annual Review.*

smaller one is driven by a 6 h.p. petroleum engine supplied by Messrs. Tomono Iron Works, which also can drive an air compressor whenever necessary, and this in conjunction with the air filling device of the 30 kw. dynamo-Diesel engine can make starting air of 25 kgs. per sq. cm.

Further, in the engine room is a 3 h.p. general service pump which can be independently used for pumping bilge, ballast water as well as for fuel oil transfer.

Although the ship is small, special care has been given for the exhaust gas boiler installation, which can produce steam at a pressure of 1 kg. per sq. cm. by the exhaust gas of the main engine only, which can be readily used for the heating, cooking and baths. This boiler has a diameter of 760 mm. and a height of 260 mm. with a very large heating surface for the absorption of exhaust heat and also can be utilized as a silencer. A Yokohama special simple burner being fitted, steam can be produced by burning oil as well when in port or whenever required, for that compressed air or steam is used.

A DeLaval's lubricating oil purifier is also fitted in the engine room.

Trial Results

The official measured mile trials were carried out off the Yokohama Harbor on August 15, 1932, and the following results were obtained :—

Sea : rough
Draught, mean : 1.7 meters.
Speeds : Maximum 12.481 knots ; mean 11.153 knots
R.P.M. of the main engine, mean : 344.5
B.H.P., mean : 351.5

For the starting and reversing tests, an air tank of 800 liters at 25 kgs. was used and it was possible to start the engine 18 times astern and ahead alternately.

Railway Construction Pushed by Manchukuo

(Continued from page 203)

freight traffic and of passengers (the latter of secondary importance) will be an interesting study, as farm products from Manchuria are bound to increase by leaps and bounds, providing the new state is wisely governed by the experienced leaders at its helm. They must provide peace and order for the people. It is necessary that the people be led with care, firmness and patience. They have been brought up under the corrupt and easy-going old-fashioned régime and they cannot be rushed headlong into ultra-modern fashions in a controlled and planned economic scheme all of a sudden.

Below are data for the state lines managed by the Mukden bureau.

Some of the figures for these state lines are misleading, as they were built by soldiers or by forced conscript labor. The mileages of the three systems are :

	Miles
Manchukuo Railways	2,146
Chinese	1,150
South Manchuria	700
Total	3,996

Until the present they never operated along the lines of business-like co-operation. But things are improving as order is being restored. As it continues to be maintained we shall be able to see how these nearly 4,000 miles of railways will open up the fertile valleys of North Manchuria, where the possibilities are still virtually unknown.

MANCHUKUO STATE LINES

Railway	*Miles*	*Construction Cost*	*1931 Revenue*	*Expense*	*Balance*
		In 1,000 silver dollars			
Changchun-Kirin-Tunhua ..	211	33,967	5,167	4,263	904
Ssupingkai-Taonan	273	25,000	8,100	6,000	2,100
Taonan-Anganghsi	140	12,600	4,425	2,529	1,896
Tsitsihar-Koshan	132	8,910	2,825	1,370	1,455
Taonan-Solun	52	470	65	80	—15
Hulan-Hailun	138	12,000	4,471	3,030	1,441
Mukden-Hailung-Kirin	313	41,500	11,395	6,380	5,015
Mukden-Shanhaikwan and branches	887	48,430	10,362	7,875	2,487
Total	2,146	182,877	46,810	31,527	14,283

Electric Service Corporation

An item of unusual interest in the business activities of Shanghai is the recent change in ownership, operation and policy of one of the established Nanking Road firms, conceded to be one of the pioneers in the radio industry in the Far East.

During October, Mr. Harry S. Janes, for many years Vice-President and Director of the Automatic Electric Company of Chicago, together with a group of interested friends, acquired the controlling shares of the Electric Service Corporation, whose head office is at No. 20 Nanking Road, Mr. Janes thereby becoming its active head and President, and Mr. Roy E. De Lay retiring. The Electric Service Corporation has retail shops at 20 and 118 Nanking Road and in the Navy Y.M.C.A. building, beside the Willard Storage Battery Station in the Western district.

Under the new management, Mr. John F. Stevens, Jr., has become first Vice-President, and will devote his time to sales organization and will be in direct charge of the company's interests under Mr. Janes. Mr. Stevens is the son of the famous engineer and railroad builder in America, who was responsible for the building of the Panama Canal and who is known to many in this part of the world as chairman of the Inter-Allied Technical Board, in charge of operation of the Chinese Eastern and Trans-Siberian Railways in Manchuria.

The new arrangement of this company provides for a Nanking Road Service Department, under the supervision of Mr. Eric Marshall, Works Manager. Mr. Marshall has had many years' experience in radio application, as well as other sound-producing lines, and will be assisted by Mr. C. P. Taylor, Service Manager, who will be in charge of the Works Office.

Japan's Electrical Trade

Japan's imports of telegraph and telephone apparatus as a whole decreased sharply between 1928 and 1931. In the former year their value was Y.3,982,000 ; in 1930, Y.1,834,200 ; and in 1931, Y.1,224,400. The trade in radio receiving sets and parts was, however, fairly well maintained, and imports last year were Y.417,700 in value, as compared with Y.322,600 in 1930 and Y.594,000 in 1928.

A large amount of automatic telephone material has been installed in Japan, a great proportion being of American origin, and most of the remainder German. Not only has the system been in operation for some years in the large cities, but it has also been introduced in a few of the smaller towns, and at the end of 1930 there were said to be 108,100 American automatic telephone installations and 30,500 German, besides 6,000 of English origin.

The United States during the period under review made substantial progress in the trade in low-pressure electrical material, partly because of the participation of two powerful American electrical manufacturing concerns in Japanese production by the establishment of branch factories in the country. This step had a beneficial influence with the authorities in connection with contracts for material not made locally.

The greater proportion of the trade in radio receivers fell to the United States, but orders have been on a low level recently because of the prevailing depression. In ignition apparatus the trade is shared between the United States, Germany, Great Britain, and Switzerland. German batteries are said to be dear compared with American. In electro-medical apparatus, however, Germany has recovered her pre-war position.

In regard to Japanese production of low-pressure apparatus it is difficult to obtain precise details. Apparently 86 per cent of the country's requirements of telegraphic and telephonic material are supplied by local manufacture, but at the same time it is evident that opportunities for import trade continue to arise as new inventions and improved designs are placed in the market by American and European firms. Nor is it considered likely that import trade will cease in the more complicated apparatus connected with long-distance signalling, electro-medicine, measuring, and automatic regulation.

When normal conditions return there should be a demand for the latest products of the radio industry, including both telegraphy and telephony, and for materials for television. There should also be a market for improved cinematograph apparatus.—*Electrical Review.*

Engineering Notes

INDUSTRIAL

OIL STORAGE TANKS—Mr. Kojiro Matsukata, of Japan, has decided to purchase land covering 15,000 tsubo in the Tsurumi reclaimed area, on which to construct storage tanks, in connection with his recent oil contract with the Naphtha Export Trust of the U.S.S.R.

PLANT IN MANCHURIA—The construction of the first hydro-electric station in Manchuria with a capacity of 50,000 kw. is proposed by the Manchukuo Government. The South Manchuria Railway Co. is also contemplating the erection of a 50,000 kw. thermal station for the extension of its existing undertaking.

ARSENAL FOR TUNGCHOW—The construction of an arsenal at Tungchow, about forty miles East of Peiping, has been decided upon by the Peiping Military Commission. Plans are being drafted by the German experts. A sum of $150,000 for construction of an aviation field at Tsinghua Yuan, near Tsinghua University, was also appropriated.

CANTON PROJECTS -In a rapid survey of Canton's progress, Mayor Liu Chi-wen stated that a new electric plant of 24,000 kilowatts is to be established in Honam. To prevent erosion, the Honam Bund is to be constructed from Chow Tou Chiu (opposite Shameen) to the Chukiang bridge and preparations are being made to construct another bridge from the Bund to Ou Chow Street, Honam. The bridge will be close to the wharves, now under construction.

THREE YEAR PLAN—The Kiangsi Provincial Department of Reconstruction is drafting a three-years program for industrial development in Kiangsi. The plans include the opening of farms and ranches, establishment of an experimental brewery station, development of the forests at Hwangkang (north-western Kiangsi), opening of sericultural experimental stations and tea plantations. Steps will also be taken to exploit the coal mines at Yukan (north-eastern Kiangsi) and Tienho (western Kiangsi). To facilitate communication services, a long-distance telephone system will also be installed.

JAPANESE HARBOR WORKS—Large quantities of sheet pilings have recently been consigned to Japan for harbor works in Osaka, Yokohama and smaller bases for the Japanese fleet on the West coast. These came from Germany, and are made from a special iron containing a percentage of copper, rendering them resistant to rust. The material is unusually tough and possesses a high tensile strength, so that the sheet pilings can be rammed into hard ground without bending. Although a similar material is being produced in Japan, the German was selected because it alone possesses the necessary qualities to provide the necessary watertight enclosure.

JAPANESE POWER PLANTS—The Yahagi Hydro-Electric Power Company set about constructing a power station at Taifu, in Gifu Prefecture, in December. Funds needed for the scheme will be about Y.11,000,000. Early in the New Year the Nippon Denryoku K.K. will prepare for the erection of its proposed 65,000 kw. Tsurigane power station ; the work will be completed in two or three years. The Ujigawa Electric Company is also proposing to proceed with the erection of its Nagatono station (10,000 kw.) on the Obara River. In addition, applications have been filed for the operation of thermal power stations by the Sanyo Central Hydro-electric Power Company (35,000 kw.), the Kobe Municipal Electric Bureau (35,000 kw.), the Osaka Municipal Electric Bureau (10,000 kw.), and the Nankai Railway Company (10,000 kw.).

NANKING WATERWORKS—A contract has been signed between the Municipality of Nanking and a banking syndicate for a loan of $300,000 for the completion of Nanking Waterworks. Work has been going on for some time, but due to financial difficulties of the Municipal authorities, progress has been retarded.

DAIREN SULPHUR FACTORY—Officials of the Ministry of Overseas Affairs and representatives of the South Manchuria Railway Co., have decided to establish a sulphur factory in Dairen with a capital of Y.20,000,000. The factory will produce 100,000 tons of sulphur yearly, according to estimate.

HAICHOW HARBOR—According to a Chinese report from Hsuchow the Siemens Company has been granted a contract for $1,000,000 for the construction of the harbor at Haichow, which is the eastern terminus of the Lunghai Railway, which will eventually run from coast into the far north-west of China through Sianfu, the Shensi capital.

IMPROVEMENT SCHEME—An elaborate plan for the beautification of Tokyo is shortly to be put into effect if plans of the Ministry of Home Affairs materialize. This will be the first application of Article 15 of the Town Planning Law, which gives the Home Office the right to designate the kind of building which may be erected within a certain area, etc. The Home Office also has under consideration a plan for improving all towns and cities within a radius of about 60 miles from Tokyo Station.

GAS COMPRESSOR—The Ishikawajima Shipbuilding and Engineering Co., Ltd., which holds a license for building Sulzer high pressure gas compressors, has recently booked an order for a five-stage gas compressor and a circulating pump for the new Nagoya ammonia works of the Yahagi Suiryoku K.K. The gas compressor will have a capacity of 3,400 cub. meters per hour at a pressure of 150 atm. (2,150 lb. per sq. in.), whilst the circulating pump will be constructed for handling 275 cub. meters per hour at pressures of 130 to 150 atm. These machines will be built in Japan, with the exception of certain sensitive parts, such as valves, stuffing-boxes and regulating devices, which will be made in the Sulzer Works at Winterthur.

RAILWAYS

EXTENSIONS IN JAPAN—The Atenmi Electric Railway is to be extended from Tawaramachi to Fukuye (10 km.) at a cost of Y.500,000, and the Ikegami Electric Railway for a distance of about 1 km.

PROPOSED NEW LINE—The Kiangsu Department of Reconstruction is drawing plans for a railway linking Haichow, on the northern coast, with Tungchow, near the mouth of the Yangtze. The railway, which will pass Yencheng, Fowning, Kuanyun, and other important cities, will be approximately 200 miles long, and will link up with the Lunghai Railway at Haichow. Surveys are now being conducted.

ORDERS FOR ENGLAND—$1,900,000 has been set aside for the purchase of locomotives and coaches for the Canton-Shaokwan Railway and the Canton-Samshui Railway. Orders for these vehicles will be placed with engineering firms in England. Four motor coaches will be placed on service on the Canton-Shamshui Railway, running between Canton and Fatshan. These will also be ordered from England, each vehicle holding one hundred passengers. Passenger traffic on this line has increased tenfold compared with a year ago.

LIGHT RAILWAY—Construction is expected to start soon of a light railway which is to run between Wuhu and Chapoo, a town to the east of the Yangtze city. The project will cost about $2,000,000 and it is to be financed by capital raised from private sources.

MATERIAL ARRIVES—Shipments of railway materials purchased by the Ministry of Railways for the construction of the Chuchow-Shiuchow section of the Canton-Hankow Railway are arriving from England. The first shipment has already reached Canton while the second is due. The first shipment consists of 65,092 pieces of wooden sleepers and 31 steam shovels, costing £19,300. They were purchased from funds made available from the British Boxer Indemnity Refund.

SURVEY PLANNED—Arrangements are being made by the Kiangsi Provincial Department of Reconstruction for the loan of engineers from the Chekiang Provincial Authorities to survey the proposed Nanchang-Kiangshan railway line. With the Hangchow-Kiangshan Railway nearing completion, the Kiangsi authorities are planning the construction of a Line as a continuation of that railway to Nanchang. The cost of the survey will be about $113,000 and will take nearly a year to complete.

PROPOSED RAILWAY—Canton, February 22.- The construction of a light railway as an extension of the Canton-Samshui Railway terminating at the port of Wuchow in S.E. Kwangsi, was decided upon at a meeting of the South-western Political Affairs Committee. The proposed railway will pass Szewui, Kwangning, and other populous cities in western Kwangtung before terminating at Wuchow, just across the Kwangsi border. At present river steamers constitute the only means of communication between the two provinces.

PLANE EXPANSION—A project to double track the Nanking-Shanghai Railway line between Chinkiang, Nanking, Soochow, and Shanghai is being considered by the Ministry of Railways, according to vernacular press statements.

It was said last night that Mr. Koo Meng-yu, the Minister of Railways, has approached local bankers with plans which call for the raising of $4,000,000 for the project. This sum will be used for the construction of double tracks between Shanghai and Soochow, which is the first provision of the Ministry's plan, it was declared. The reason for the contemplated project is because of the commercial expansion of the districts between the railway terminals mentioned.

LINK LINES IN CHINA—It is said that the Canton authorities are now willing to link up the Kowloon-Canton Railway with the Canton-Hankow Railway by a loop-line at Canton, provided a foreign loan of $15,000,000 is forthcoming to develop the province of Kuangtung. The two lines at Canton are separated by about six miles. The southern section of the Canton-Hankow Railway will be completed in about four years, now that funds are available from the British Boxer Indemnity. From Canton the railway goes as far as Shaokuan, and from Hankow the line runs down to Chuchow in Hunan. The portion from Shaokuan to Lohchang will be completed in eight months, but the section between Chuchow and Lohchang has to pass through high mountain ranges, hence the construction will take time and money. The construction of a loop-line joining the two railways is a very simple matter, but Canton has opposed such measure on the ground that its trade and prosperity will be captured by Hongkong. How far this view is modified by the proposed loan cannot be ascertained at present.

ENGINEERING FINANCE COMMERCE

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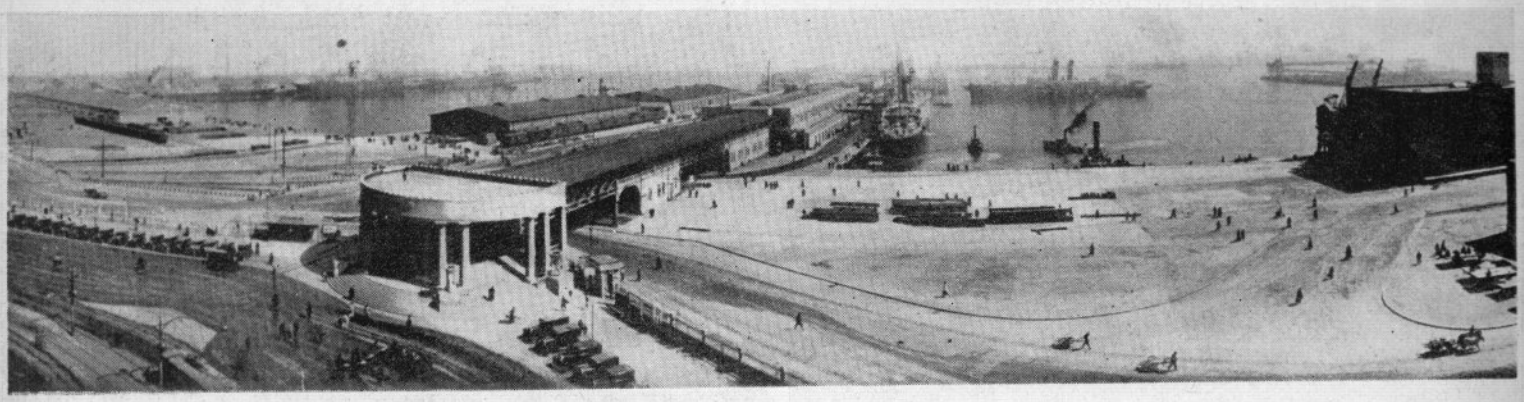
A CONSPIRACY OF SILENCE

ONE EQUITABLE SOLUTION

GENEVA-TOKYO-CHINA-MANCHOUKUO

THE INDEPENDENT STATUS OF MANCHOUKUO

Vol. XXIX | JUNE, 1933 | No. 6



Bird's Eye view of Dairen Harbor

Manchoukuo and Engineering Developments

By J. N. PENLINGTON in "The Engineer"

LAST year a flood of publications, from substantial volumes issued in London and New York to pamphlets from societies such as the League of Nations, Association of Japan, endeavored to present the Chinese and the Japanese positions, and enlighten the world on the causes, present and remote, that culminated in a sudden explosion which overnight transformed large areas of the Three Eastern Provinces (Tung San-hsing) into a battlefield, resulting in the space of six months in the complete dispossession of the old rulers and the creation of a new state, independent of the Republic of China, with a new capital removed from the old centers of intrigue and conflict.

Central Circle City of Dairen

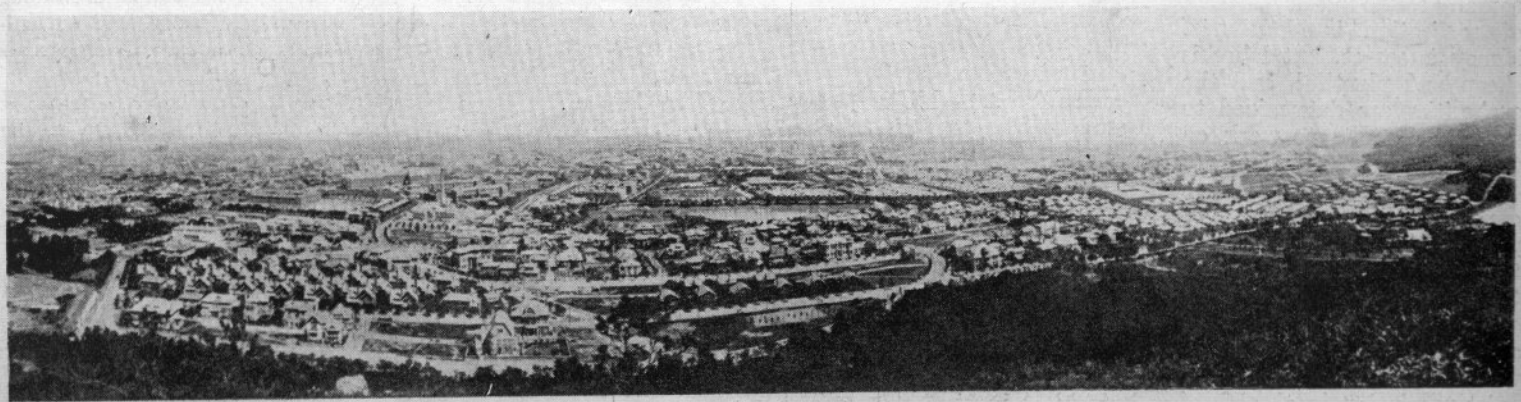
The chief creditors of Manchuria are the Japanese Government and people, not only in respect of money lent, but in regard to numerous enterprises, many on a co-operative basis, in which Chinese are claimed to have defaulted, or which were abandoned because of lawless conditions prevailing and the obstacles placed in the way of exploitation by local officials. Extraordinary tales could be told of lumber, pulp, and other industrial enterprises, started under apparently the brightest auspices and involving large preliminary outlays of capital, being gradually destroyed and finally abandoned because of exorbitant official demands and corrupt practices. Some of these enterprises, initiated years ago, will make a new start under the Government of Manchoukuo. Obligations of the old Government to Japanese semi-official banks (loans guaranteed by the Japanese Government), and debts due to the South Manchuria Railway Company, which has financed several Chinese railways, are well in excess of 10 millions sterling, and on these interest has never been paid, nor has any part of the principal been repaid.

Of other nationals who are creditors of the late Government at Mukden, the Germans were heavily interested in the huge arsenal established by Chang Tso-lin and extended by his son, while American firms are creditors for electrical installations in the towns.

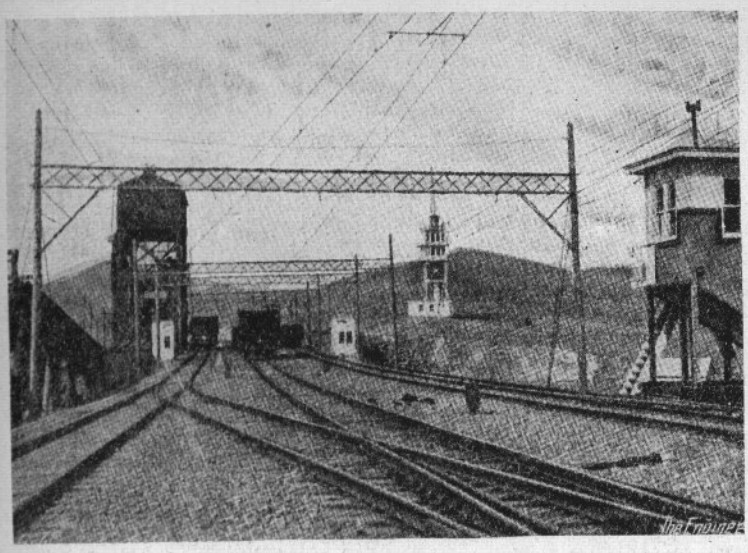
Railway Developments

The transformation that has taken place in Manchuria, while being the subject of severe criticism in some quarters, has brought with it certain decided advantages from which the people must benefit. One of the chief causes of Sino-Japanese rivalry were ill-considered plans for railway building. The projected lines numbered no less than thirty, and of these several have been completed. The Chinese object was to create a network of lines converging on the port of Hulutao, 50 miles due west of Newchwang, which was spoken of as a coming rival of Dairen.

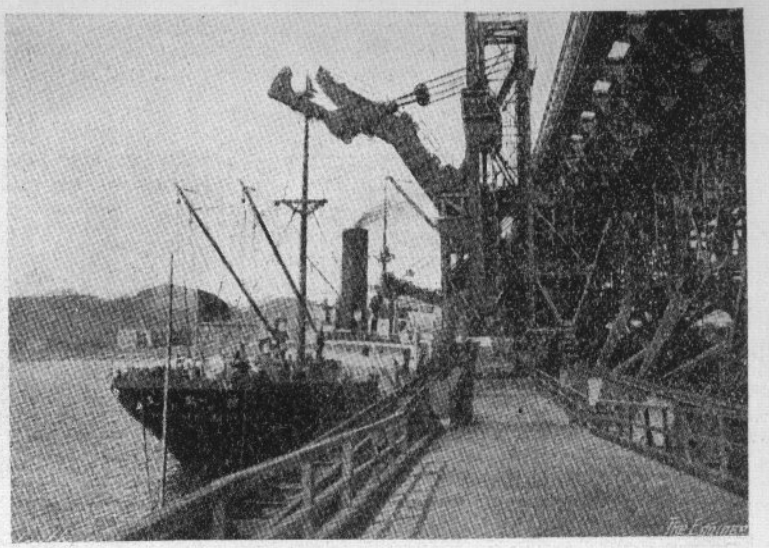
There is no reason whatever why the Chinese should not do everything possible to develop the hinterland of the port of Hulutao which can be done without injury to Japanese railway interests. The Netherlands Harbor Works Company at last report was



Bird's-Eye view of the City of Dairen



Kanseishi Coaling Yard



Kanseishi Coaling Wharf

proceeding with the construction of the breakwater, and although work has been interrupted more than once by strikes owing to non-payment of wages by the directorate of the Peking-Mukden Railway, ships are loading coal, and the port is in being, awaiting increased communication with the interior. Hulutao must grow as Dairen has grown, though in view of the huge expenditure incurred in equipping Dairen, years must pass before Hulutao can be anything like the rival the Chinese promoters hope it will be. Dairen ranks second in the list of ports of the Chinese Maritime Customs, having passed Tientsin some years ago.

Given good government, however, the prospects of Hulutao are bright. In view of the well-known disabilities of Newchwang, the oldest open port of Manchuria, frozen in winter and capable only of taking vessels of light draught, there is no adequate outlet for the produce of the Liao Valley, which the Shantung and Hopei immigrants are rapidly transforming from a pastoral to an arable country. The new conditions are bound to bring about great changes in this part of Manchuria, and make necessary a fresh attempt to improve the port of Newchwang. Twenty years ago, the Chinese authorities had the channels of the Liao River surveyed by the firm of the late Sir John Wolfe Barry, and in 1915 the result of these investigations was published, but nothing was done. Newchwang is the natural outlet of the valley, and it may be that the new Government at Changchun will consider the proposals made twenty years ago for the improvement of the delta.

Communications the Vital Need

It is commonplace to say that good means of communication, by road, rail, and sea, are the crying need of China—of all parts of the 4,000,000 square miles comprising the eighteen provinces and dependencies. Stable rule must also be postulated. Now, what appears to be a condition not to be expected in China proper actually seems in fair prospect of realization in Manchuria. Money is scarce, but labor is cheap and plentiful, and the authorities are determined to put the bandits to work on the roads. In this land of 400,000 square miles there are opportunities for a process of re-creation under conditions that only obtain south of the Great Wall in the exterritorial areas. Official plans for rail and road communication will, within a decade, work a quiet revolution in the life of the people, and the day may soon come when the Chinese fortress-farmhouse will disappear from the landscape, a few remaining to be pointed out as the remains of old castles are now studied by the archæologist. The bandit will pass with good government and improved economic conditions.

Such being the prospect, ancient centers of trade, long dormant, must revive, and regions now remote become productive and prosperous. A development of the whole country, comparable to the remarkable transformation during the past twenty-five years within the railway zones, may reasonably be expected of an agricultural people of tireless industry, whose chief need is the assurance that they themselves, and not tax officials or merciless bandits, will possess the product of their labor.

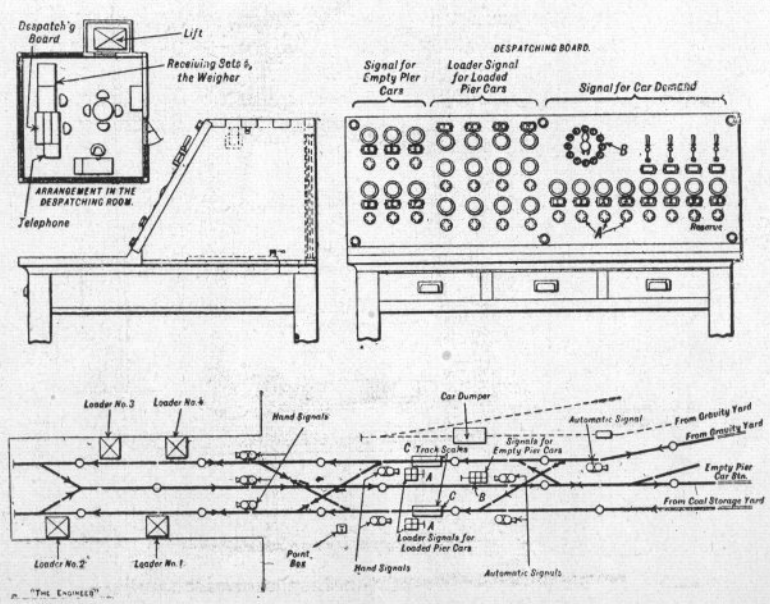
Mukden and the better-known towns of the south, where there is little agriculture, are rapidly becoming industrialized. The Japanese military authorities, at the outset of the recent disturbance, saw the necessity of motor roads, and all towns are to be connected by the ubiquitous motor omnibus. In Manchuria, as in Japan, the infant automobile industry, under military direction, is concentrating upon the production of serviceable omnibuses, trucks, and cars, uniform in type, in order to facilitate production.

It is in the north-east, north, and west of the Manchurian area, upon the great plains and in virgin forests, that the eye of the exploiter is turned, where opportunities present themselves to capital and industry, where development has repeatedly been attempted, and development work—real pioneer work—abandoned, often hastily, because of conditions that seem almost inherent in life in Manchuria.

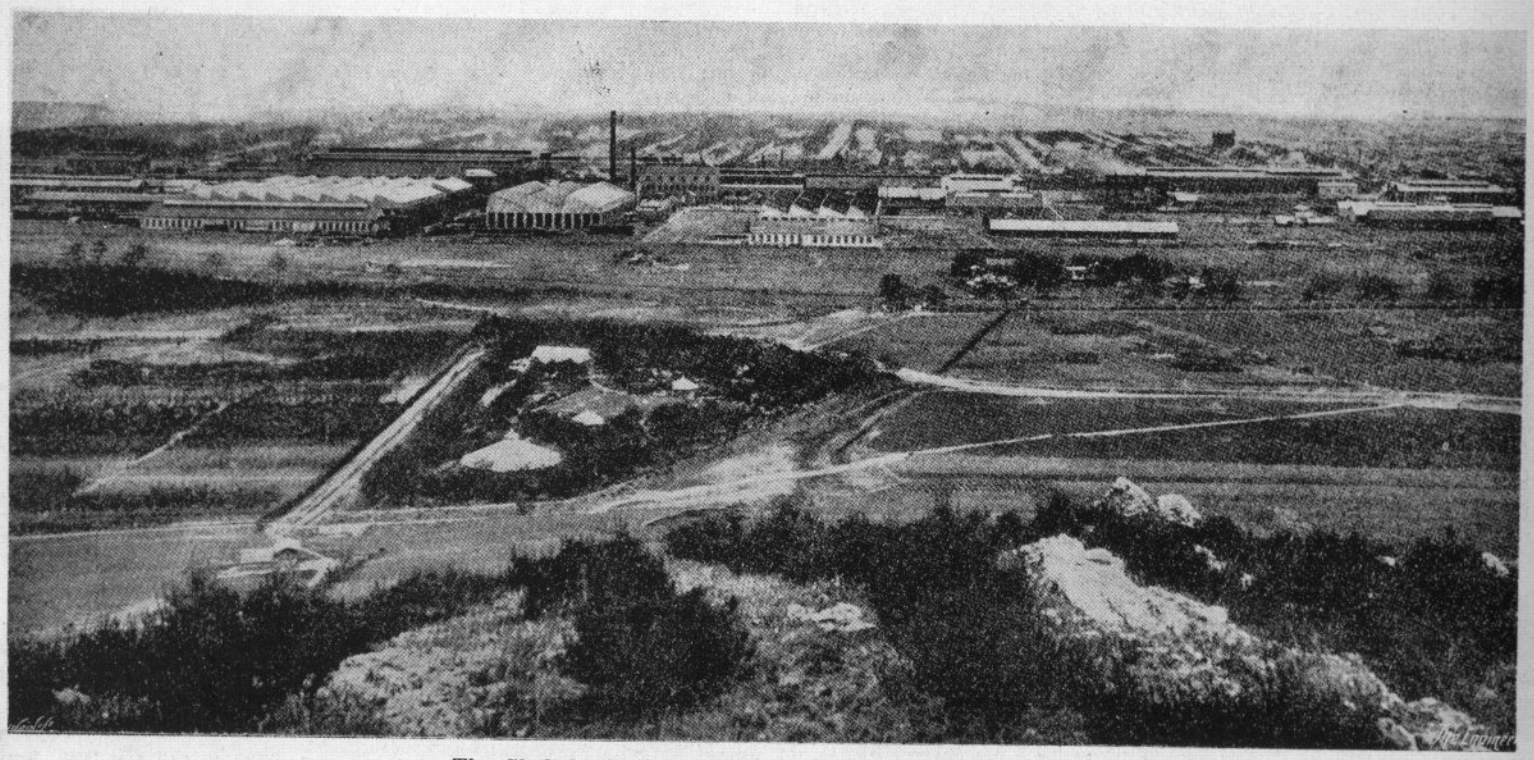
Enterprise and Foreign Capital

Since the formation in 1907 of the South Manchuria Railway Company, research work has been carried on systematically by several agencies, including the research office of the company at headquarters in Dairen; by the Eastern Asia Economic Investigation Society in Tokyo, which is affiliated with the company and was for many years under the direction of a German; by the Central Laboratory at Dairen, under Japanese direction, an institution that has rendered invaluable service to agriculture and other industry; and by the several experiment stations for agriculture and animal industry, the chief of which is that at Kungchuling, some 25 miles south-west of Changchun. These are scattered over a wide area.

One other research body was established in 1931. This



Dispatching Board and Plan of Yard



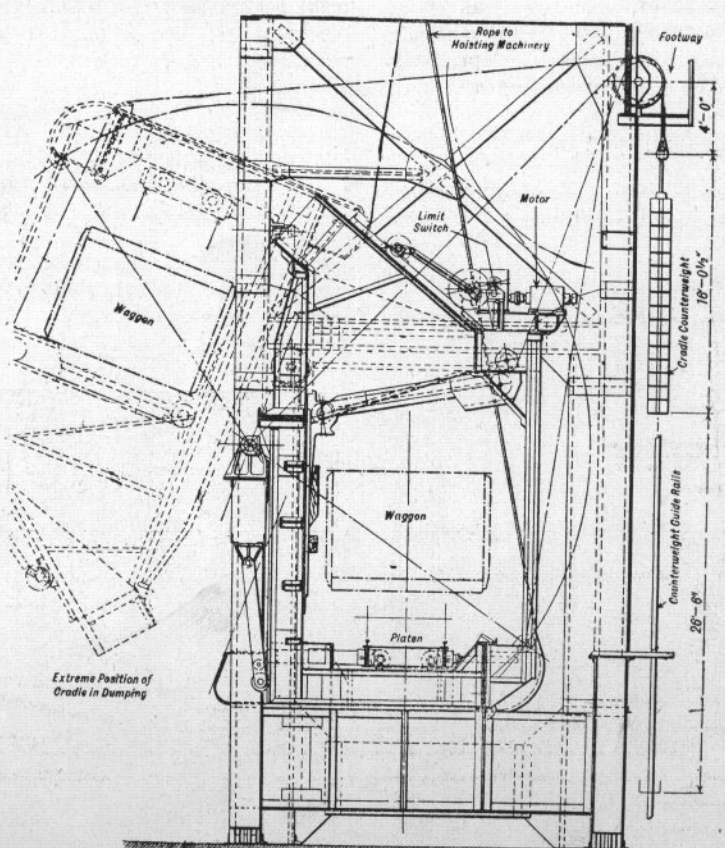
The Shakako Railway Works—South Manchuria Railway

is the Technical Board of the railway company, its head being Baron Chuzaburo Shiba, Doctor of Science and Engineering, Director of the Aeronautic Research Institute in Tokyo, Chairman of the Board of Directors of the Imperial Japanese Marine Corporation, and a member of the House of Peers. The object of the new institution, now functioning at Dairen, is the fullest development of the natural resources and industrial possibilities of the Manchurian area.

In regard to the latter, rationalization is the keynote. At the present time there are in course of formation large steel works, for which Government permission has already been obtained, and fertilizer and soda-manufacturing companies; other enterprises are in the initial stages, and where there is delay that is due to causes beyond control—the general depression and the political situation.

The Technical Board will devote its attention to the improvement and rationalization of the undertakings of the railway company—harbors, mines, ironworks; will study proposals for new engineering and other enterprises, keeping always in view reorganization from the industrial standpoint. There are many subsidiary concerns in which the parent company is financially interested, and in several instances these have made heavy demands upon the profits of the railway which, until the outbreak of September, 1931, were always large, far in excess of profits realized by railway companies in Europe and America. Such undertakings will come in for the close attention of Baron Shiba and his colleagues, whose board may be likened to the general staff of an army, making the best disposition of the industrial body, directing the forces to best advantage.

Considerable preliminary work had been accomplished by the Board before the unfortunate incident of September, 1931, threw everything for the time being into a disordered state. It was officially organized in July, 1931, and Baron Shiba spent the whole of that summer in travel through Manchuria and Korea and in the examination of sites and plants. While the incident at Mukden caused some upset of plans, the work of co-ordination of industry is proceeding, and Baron Shiba and his colleagues consider the general prospects, and the co-operation with the Chinese so long desired, now of the brightest.

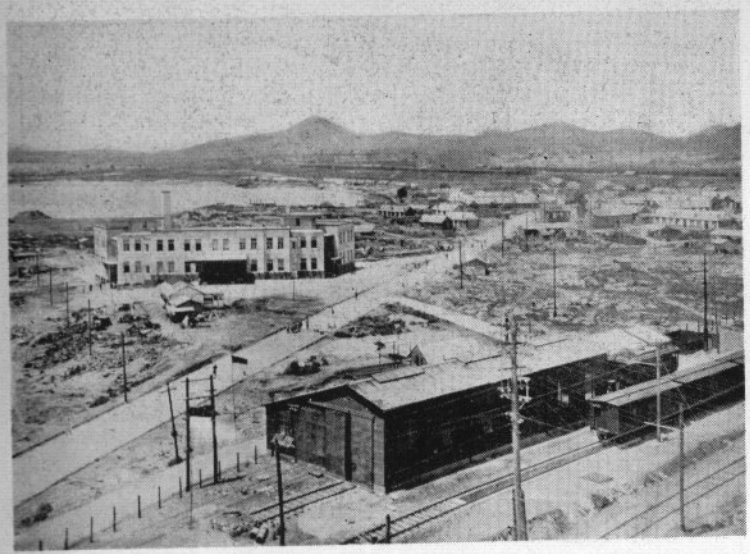


Wagon Tippler at Kanseishi

The "Open Door" in Manchuria

On July 13 last the Foreign Secretary, replying to a question in the House of Commons, said he had received no information to show that British trade in Manchuria was being penalized.

In the Kwantung Leased Territory and the narrow railway areas the Japanese took over from the Russians, the Chinese were, and actually still are, the dominating partners in trade. The Chinese population in some 1,400 square miles of territory under Japanese rule is over a million, whilst the Japanese number some 200,000. Other nationals trading in Manchuria have the same opportunities that they possess in Japan, which has never been a Free Trade country, and has always, by official control and restriction, sought to regulate the currents of trade for the national benefit. The Free Trade spirit that once ruled in England never gained the slightest footing in Japan; the whole relationship of Government and people is different, the latter being dependent upon Government to a degree inconceivable to the English people. In Manchuria, the Japanese remain the same; the system of government the same, and the people equally



General view of Kanchentzu where Kansheshi Coal Pier is Located

Showing Office of Kansheshi Coal Pier Depot, built in 1930

dependent upon authority for guidance in their affairs and practical assistance in times of difficulty.

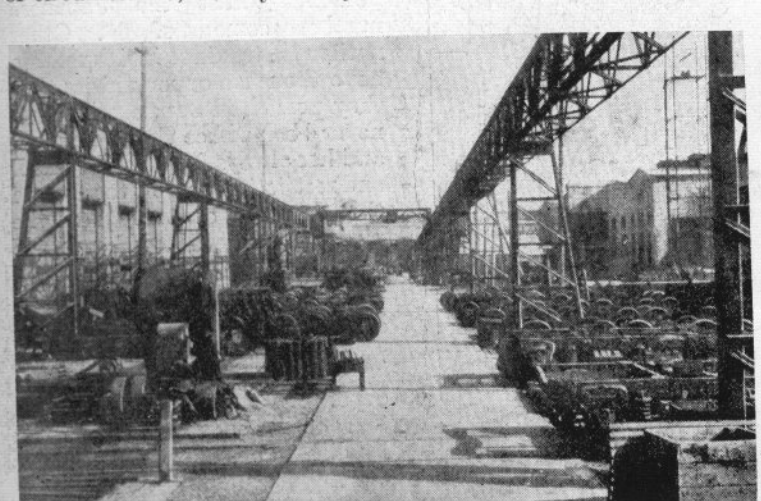
The Japanese have been nearly thirty years in Manchuria, but they will admit they have never been, and are never likely to be, the equals of the Chinese in capacity for trade. Where the Japanese succeed, as in the Indian cotton trade, we see the result of combination and well-considered plans, aided, if not initiated, by Government and maintained by methods which the individualist British trader, unaccustomed to official help, naturally considers unfair. In exactly the same way must the Japanese trade in Manchuria, notwithstanding all that might be said or thought about such political easy phrases as the "Open Door" and "Equal Opportunity." While the Japanese in Manchuria have killed the Manchester cotton trade, for example, their enterprise has widened the field for goods the Japanese do not, or can not supply. That there has always been opportunity for other nationals to trade in Manchuria is evidenced by the facts—the foreign banks and importing firms. British and American banks finance the movement of imports and exports equally with the Chinese, Japanese, and Russian banks, and progress of trade must depend upon individual capacity and initiative and local needs. Years ago I found the American bank in Harbin accepting paper of the Chinese Eastern Railway, which the British bank did not regard as good security for loans, and consequently the American bank was busy and the British bank idle. Whatever the result of the respective policies of these banks, the hard fact remains that enterprise is necessary to successful trade, and where there is enterprise there must be risk. The lordly days which made great fortunes for British hongs in China are past and gone. There are now a dozen nations equally competent and equally keen to trade in China where formerly there was one, and each man must put his dignity in his pocket and go after the business.

In view of the patent fact that the whole world, under pressure of circumstance, is busy to-day closing open doors, adding restriction to restriction, each lessening the opportunities of the individual trader, it is necessary that the department store idea be applied to commerce and industry, or the missionary-society method. It is necessary that such a market as Manchoukuo should provide in the coming years be deliberately studied and worked by a great organization, with ample capital, and technical—and, I would add, diplomatic—skill. Japanese trade in the past twenty-five years has been built up entirely by Government initiative and direction, and the system that has made this Empire one of the five Great Powers is not likely to be abandoned. It cannot be unwise advice to say that in order to succeed in the new Manchuria, it is necessary to take a leaf out of Japan's book and study the new field in a comprehensive way. In the East, the day of the individual in trade is passed; he must be part of a large and influential organization capable of dealing with Government, which is the greatest trader, in Japan, in Manchuria, and in China proper. Despite the feeling of enmity and rivalry that exists, the authorities of Nanking, Canton, and other areas watch Japan closely and copy her methods in trade and industry. In the years to come the world will have to reckon with a more formidable competitor than the Japanese ever were.

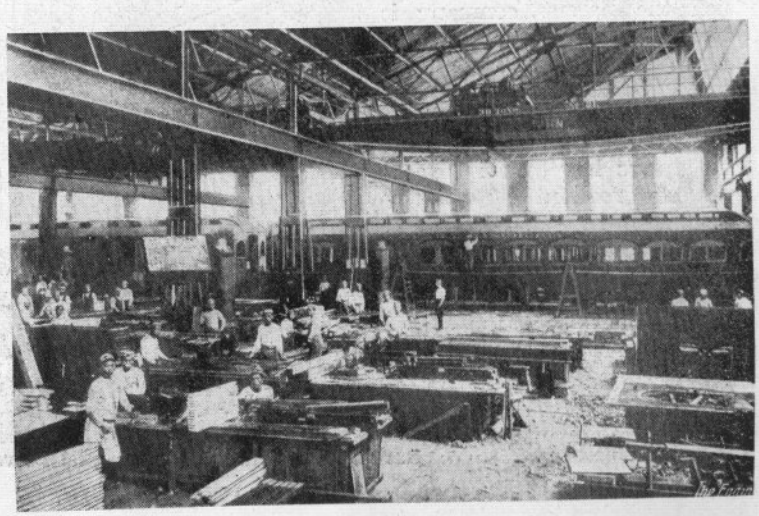
To the Japanese people, the principal gateway into Manchuria is through the port of Dairen, between which and Japan there are regular and first class services by sea and air.

The homeland is a stronghold of conservatism, the natural result of age-old traditions confirmed by an ever-growing population that cannot properly be fed and housed. But abroad, on the Asiatic mainland, amidst a race from whose early civilization the islanders have taken so much, they are becoming another people.

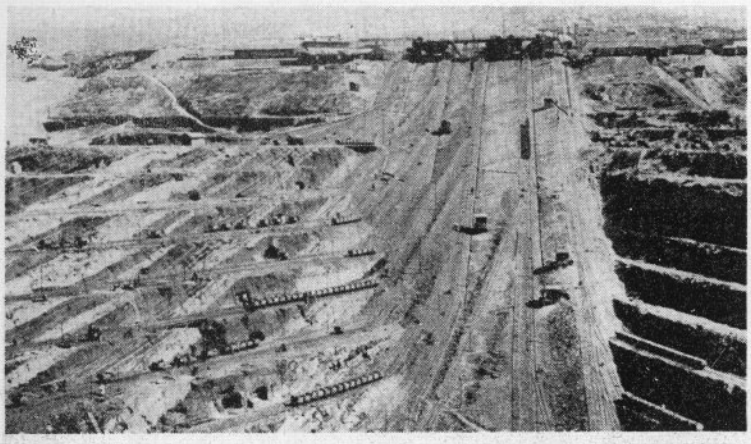
The Japanese in Manchuria are conscious of their Imperial mission. In all centers of population along the railways there has grown up a generation of Japanese who know the homeland only by repute, and who, without exaggeration, may be said to be as much Manchurian as the Chinese themselves.



Wheel and Axle Yard at the Shakako Works



Carpenters' Shop at the Shakako Works



The open cut at Fushun Colliery showing two views of Kojoshi open-cut 300 feet Deep

With the abolition of the railway zone as such, of all extra-territoriality, and the vexatious conditions attaching to this system; and now that the Japanese are free to settle wherever they can make a living, the new Manchurian must increase in stature and develop into a distinct type—still Japanese in his love for the Fatherland, but continental in outlook and physique, for he lives in altogether a finer climate and a better land. Everything depends upon the smooth progress of government and the maintenance of peace, and, given these conditions, from the group of Asiatic peoples now inhabiting Manchuria (Chinese, Japanese, and Korean, and to a lesser extent the Mongolian), must gradually evolve a new type. Their tastes and traditions are not widely divergent, and intermarriage must play its part in fusing the whole. Strongest of all unifying forces, ultimately, will be that of self-interest, stimulated immensely by the progress of ordered government, to which the mass of Chinese are complete strangers. The day may come when they will flourish in Manchuria, as they do in Hongkong, the Straits Settlements, and in all countries where they are permitted to live and trade freely.

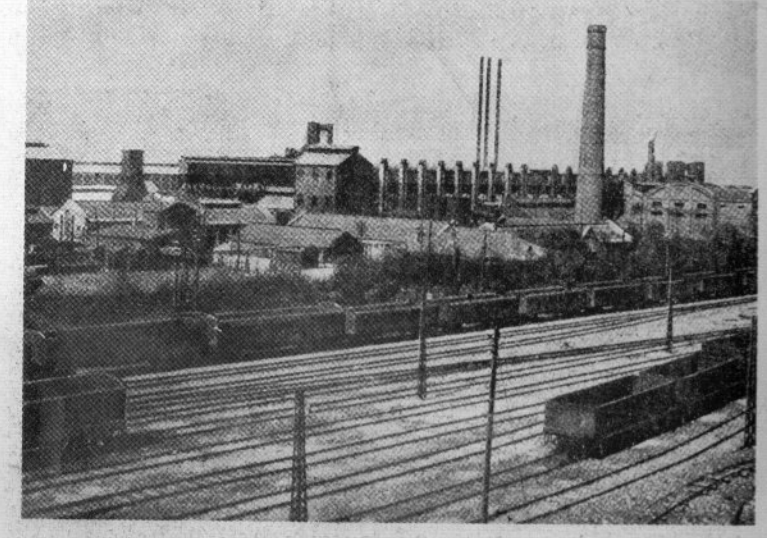
The Port of Dairen

Dairen to-day has all the facilities of a first class port, and though no longer associated with the Chinese Maritime Customs, is second only to Shanghai in the amount of customs revenue raised, a due proportion of which is reserved for the service of the Chinese National Debt, and remitted to Nanking. The principal engineering establishment of the port are the railway shops of the South Manchuria Railway Company, which now do much building and repairing work for other companies, mainly Chinese. In the past decade the most important addition to the equipment of the port is the great coaling pier at Kanseishi, a few miles across the harbor, where Fushun coal, after being transported by rail for 200 miles, is tipped into ships' holds for export to Japan, China ports and further south.

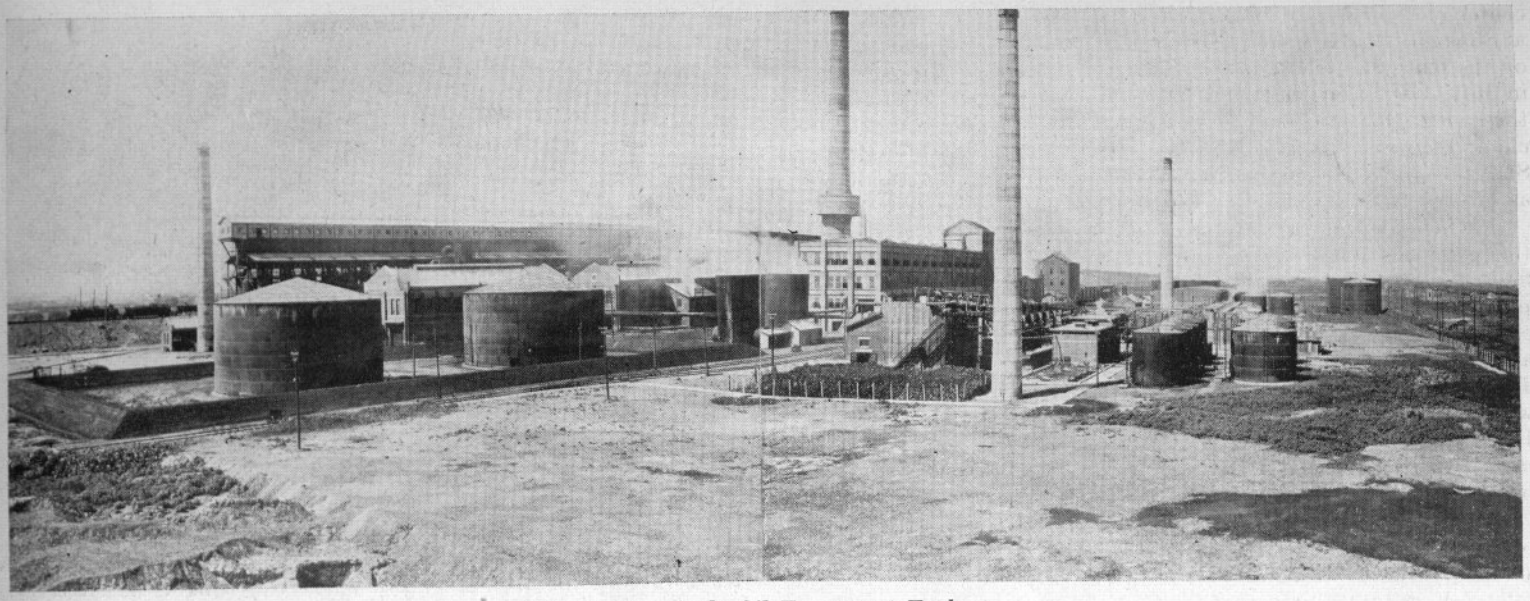
In addition to the railway, there are two excellent motor roads connecting Dairen and Port Arthur, both of which are considerably shorter than the route by rail, 31 miles. The old road, asphalted, follows the southern coast line, providing a rapid means of communication, linking up numerous pretty bays and inlets that are now popular residential areas, while one but recently opened passes along the northern coast through a rich agricultural and orchard country, and through prosperous Chinese villages, in one of which Nogi met Stoessel after the surrender of the forts at Port Arthur. This road more closely follows the railway, and as he travels through the beautiful country, made glorious by the incomparable kaoliang, ready for the harvester, the motorist reflects that in no other part of Manchuria may he safely leave the town so far behind. Here he is in a bandit-free area under the administration of Japan.

In Dairen, there has been a steady extension westwards of residential areas for Japanese, rows of strongly built houses reminding one of Lancashire. The severe winter climate makes substantial building absolutely necessary, but these houses of solid brick and double windows have no likeness to an English or Russian house inside, for the interior is Japanese. The floors are of matting, and all the usual Japanese interior features are retained, the domestic life of the homeland being thus to this extent preserved. And the Japanese worker returning home at the end of the day will discard his foreign clothes and don the comfortable kimono, after the daily hot bath, also an institution which few Japanese can live without. In the old Russian town is the original residential section of Dairen, a quarter of well-laid-out streets, with what appear to be still the most substantial houses in the port. These, thirty years ago, housed the numerous employees of the Chinese Eastern Railway, and are now occupied by officials of the South Manchuria Railway and members of the international community, not excluding rich Chinese, who find a safer haven here than in Shanghai. Kidnapping is unknown in Dairen, but it is common in Shanghai, where the police are helpless, the

Pithead Equipment at Oyama Shaft



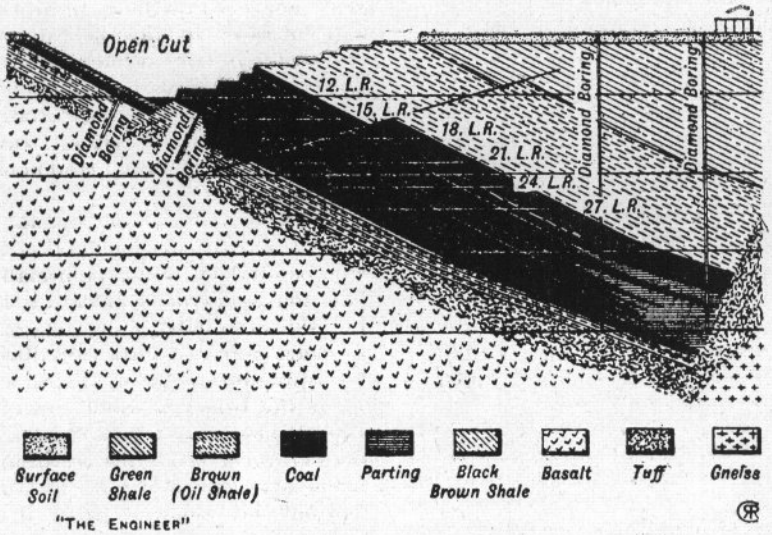
Mond Gas Plant at Fushun



View of the Shale Oil Factory at Fushun

victims' families not daring to report until the bandits' demands are satisfied.

Little but "Russian Town" remains in Dairen that is Russian in origin. The streets of the port as first laid out radiated from "circles" or circuses, and the Central Circle remains the center of Dairen, but when they assumed control, the Japanese adopted the block system, and so the town has expanded on something like the American plan. The population to-day is approaching 300,000, and, as in the case of all towns in the railway zone, Dairen is the creation of the South Manchuria Railway Company, which has provided waterworks and sewage; tram, and other systems of communication; hospitals, and parks, and built and equipped fine schools of all grades, in addition to maintaining the railway and the harbor, which are the two sources of prosperity of the inhabitants.



Geological Formation at Fushun

The Railway Shops at Shakako

Everything in Dairen begins in the year 1907, the year following the promulgation of the Imperial Ordinance establishing the South Manchuria Railway Company, a semi-official concern, the shares of which may be legally owned only by Japanese and Chinese. The president and vice-president are appointed with the approval of the Emperor, and the former is invariably a statesman, the last to occupy the presidential office being at the time of writing, autumn, 1932, the Foreign Minister of the Government of Japan, Count Uchida. The capital of the company, originally Y.200,000,000, is to-day Y.440,000,000, and its investments amount to nearly Y.800,000,000.

At the beginning the railway shops were temporarily established near the Dairen terminus, but there being no room so near the

Extracting Oil Shale

Oil Shale on Hillside, Coal at Bottom

center of the city for expansion, a large area of land was secured at Shakako, in the western part of Dairen, near the Shakako Station on the main line of the S.M.R. Plans for the new shops were made in July, 1907, and the works completed in August, 1911. During these years there were repair shops at Kungchuling, south of Changchun, Liaoyang, and at Antung, but with the completion of the Shakako works these were gradually closed down—that at Liaoyang as late as 1930—owing to the general depression prevailing.

Wherever the Japanese go, they will take with them not only the indispensable hot bath, but they will plant trees, and one finds trees in the most unlikely places. These are doubtless good points in the national character, but none the less one does not expect to run into a cherry tree while leaving a foundry and crossing a railway which runs into a sort of blast-furnace atmosphere. There stood the cherry tree in between, to flower in the spring, when every Japanese would be inspired to poetry at the sight. I remarked to my guide that that sort of thing did not happen in Lancashire, where everything was black and grim, as it should be—and he smiled.

The Shakako shops—are now the only manufacturing and repair works of the South Manchuria Railway Company, but they are very extensive and complete. They manufacture and repair rolling stock, machinery and tools, all kinds of railway equipment, and of late years have built to the order of Chinese railway companies.

The total area occupied by the shops and the quarters attached is 1,017,699 square meters, and a floor space of 69,824 square meters is provided in eighty-one buildings, brick, steel-framed, and wooden. All shops are equipped with heating systems, absolutely necessary in the prevailing climatic conditions, and all wood-working buildings with automatic fire sprinklers.

The amount of capital invested in the works is to date :—

	Yen.
Buildings	2,604,716
Rolling stock	81,556
Machinery	2,054,764
Construction	1,060,258
Rails	567,318
	6,368,612

and their capacity for manufacture and repair in one year is as follows :—

Locomotives	Manufactured, 30 ; repair,	300
Passenger cars	Manufactured, 45 ; repair,	420
Goods wagons ..	Manufactured, 650 ; repair,	3,600

Rolling stock repairs—time averages :

Locomotives	6.0 days
Passenger cars	6.5 ,,
Goods wagons	1.7 ,,

(On the Government Railways of Japan (narrow gauge) the average time for locomotive repairs is five days.)

In connection with the shortening of repair days for rolling stock, the Shakako works claim a record for locomotives, in comparison with the works of Crewe, and of America, or Japan. The desire to emulate and excel the West in the creations of the West is the strongest motive force in modern Japan, and one wonders what will happen when the Chinese are seized with the same sort of ambition.

In normal times production was valued at about Y.10,000,000 per annum, but since the advent of the depression there has been some decrease, and production for the year ending March, 1931, was as follows :—

	Yen.
Rolling stock ; value of new construction and repairs	3,930,000
Miscellaneous work	3,690,000
Total	7,620,000
NEW CONSTRUCTION :	
Motor-cars	16
Passenger cars	5
Goods wagons	91
REPAIRS :	
Locomotives	200
Passenger cars	285
Goods wagons	2,137

Personnel

The *personnel* of the works comprises the following ;

Office staff		*Workmen*	
Japanese	Manchurian	Japanese	Manchurian
450	56	719	700

Workers temporarily employed not included.

A Safety Committee is active in the investigation and improvement of all means for the prevention of accidents and injury to health, and through the activities of this Committee the injury percentage is gradually decreasing. In this connection, there are "propaganda weeks" and other means to arouse workers' interest in their own welfare. These take place three times yearly, when emphasis is laid on means for the prevention of accident and injury, and diligence and efficiency inculcated, together with care of machines and conservation of materials. The latter is especially emphasized during "Saving Week," when there are lectures on the saving of power and shop materials.

Hours and Pay.—The hours for workmen are from 7 a.m. to 5 p.m., and for the office staff from 8 to 4. The wage system used for workmen and temporary employees consists of the Rowan system, and time work.

Training School.—An apprentices' training school provides courses covering four years. There are under training at present 274 boys, Japanese and Manchurian.

Design and Research.—Monthly circulars concerning design and improvements suggested by the employees are published, and the number of such designs and improvements adopted during the past year, 1931, was seventeen. These researches in the main were concerned with the improvement of organization of the works, concentrated management of tools, time and motion study, tool boy and mail boy systems, standardizing of tools, welding, shortening of repair days for rolling stock, use of domestic products, regulation of time limit of products, arrangement of machines and tools, centrifugal casting, transportation, limit gauging (viz., templates and fixtures), and machining cutting allowance, especially for brasses.

The men, Japanese and Manchurian, at Shakako works, appear to get on well together. There are no labor troubles and no labor unions, and the labor politician has not yet made his appearance. The management is proud of the fact that the workers are nearly all old-timers, the great majority having been in the shops for at least thirteen years. Skilled workers to-day come only from the apprentices' school, and all connected with the extensive shops, from the superintendent down, live under pleasant conditions, their homes being in tree-lined avenues, while they and their families are within a few miles of beautiful seaside resorts, not to speak of the attractions of the city of which they are a part, though quite distinct and separate from it. The manager, summing up the advantages of work and life at Shakako, wisely observed : "It is a very important condition for our works," and the visitor is bound to agree.

The engineers of the South Manchurian Railway take justifiable pride in the new coaling wharf at Kanseishi, a point across the inner bay a mile north of Dairen Harbor. It was completed in 1930 at a cost exceeding a million pounds sterling.

The South Manchuria Railway Company maintains coaling stations at Newchwang, Riojun (Port Arthur), and Dairen, all being used for the export of Fushun and Yentai coal. The original mechanical loading equipment at Dairen, which is within the harbor proper, is modelled on that at Durban, and was erected according to the specifications of a German company. The materials and devices used at the Kanseishi plant are principally American.

Preliminary work for the new coaling station involved the dredging of the approaches to take steamers up to 10,000 tons, and the construction of a breakwater extending over 3,000-ft. Dredging was begun in September, 1926. This work, together with breakwater construction, the erection of a steel pier 550 m. long, an extensive storage yard, two transporter bridges, and all necessary mechanical devices, was completed in July, 1930. The actual cost of the whole work was Y.12,042,732.

Kanseishi has a loading capacity of 12,500 tons per day, and four vessels of from 5,000 to 10,000 tons can be berthed simultaneously. While at present it is not working at full pressure, the coal trains from the mines at Fushun, 250 miles to the north-east, form the great bulk of the traffic of the South Manchuria Railway,

with Japan, the China Coast ports, and points further south the overseas markets for Fushun coal.

The Coaling Wharf at Kanseishi

In all the great industrial undertakings of Japan in Manchuria, provision must be made, not only for the effective execution of the work itself, but for the care and comfort of the Japanese workers who, throughout Manchuria, North and South, live lonely lives. This may appear remarkable when it is considered how closely akin Japanese and Chinese are in so many respects, but there is no intermingling of the two, except on formal occasions, when the official classes come together. And recent events have widened the natural breach. This observation applies with still greater force to the workers of the two nations; there is no intimacy of any sort, and there is every necessity for social institutions such as the Club at Kanseishi, where wholesome recreation may be obtained by seamen while their vessels are coaling. This club, of course, is used by men of all nationalities, but Japanese are in the great majority.

A fine asphalted motor road connects the coaling station with Dairen, circling the bay, and once outside the limits of Kanseishi, one is so obviously in China, though in Japanese territory, that the sudden transition is startling. The Chinese life and character dominate the scene. The ubiquitous carter and coolie, ever active, ever moving, the teams of whole families of animals, yoked abreast and in tandem, horses, mules, donkeys, with their foals trotting alongside, present pictures of liveliness and activity that are exhilarating. Their importance in the scheme of things has been remembered by the road-builder, and only half of the road width is asphalted.

From the top of the Dispatcher Tower, a view of the Kanseishi plant is obtained. The outside platform of the tower is 72-ft. above ground level, and the only means of ascent is a lift. All the movements of loading, and the coming and going of wagon trains, laden and empty, are clearly observable, the work being done with an ease, precision, and regularity that must become monotonous to the operators above and below—so thoroughly typical of the mechanical age. In the tower, three men sit so many hours a day, pressing buttons and registering records, and below, trainloads of coal are poured into ships' holds with no more human effort than is entailed by the pulling of a lever. What a contrast, this silent work, to the noisy activity and unceasing movement, accompanied by rhythmic sing-song, that was the feature of the old coaling days at Moji, when men and women coal-passers formed an "endless chain" between barge and bunker, and coaled a ship by means of baskets holding a few pounds at a time, passing rapidly from hand to hand!

Is the mechanical world over-reaching itself with its deadly efficiency? The millions of China must be fed. At Kanseishi, work is done by a hundred men which in former days would have given employment and rice to thousands. Whatever may be said in defence of labor-saving machinery, at the present time of universal slump in commerce and industry it is but an added misery. Such devices are for prosperous times only, when there is work enough and for all.

Kanseishi Capacity and Coal Exports

The latest issue of *The Goods Year Book of the Port of Dairen*, covering the trade of Dairen for the year 1931, gives the following as the principal equipment and capacity of the Kanseishi Pier, with the total exports of coal from the port for the past six years:—

One car dumper, maximum capacity 1,800 tons per hour.

Four loaders, each of maximum capacity of 600 tons per hour.

Six pier wagons, capacity of each 65 tons.

Two bridge transporters, each with coaling capacity of 280 tons per hour.

Four electric locomotives, each with tractive power of forty wagons holding 30 tons.

Coal yard, maximum storage capacity 300,000 tons, area 130,000 square meters.

Figures are given in the year book of the exports of Fushun coal during the past six years compared with the total exports of the port, which are reproduced below:

1926 .. 2,140,716 tons, compared with total exports 4.15%
1927 .. 2,613,544 tons, compared with total exports 4.46%
1928 .. 2,701,474 tons, compared with total exports 4.32%
1929 .. 2,774,664 tons, compared with total exports 4.00%
1930 .. 2,186,858 tons, compared with total exports 4.16%
1931 .. 2,481,671 tons, compared with total exports 4.18%

The present loading capacity of the pier is 3,800,000 tons per annum; this is capable of expansion to five millions.

Within a mile of the pier is an extensive deposit of limestone, which is being quarried for local use and for export.

The Dispatching System

The superintendent of the Kanseishi coal pier, Mr. S. Hamano, explained the mechanical loading system to me in the following terms:—

In the room of the dispatching tower three men are at work. The first is in charge of planning; the second dispatches his orders by using a series of push-buttons; the third controls weighing.

Planning.—Stowage plans are delivered by the stowage master; the number of wagons, and the quantity and class of coal in the gravity yard are reported to him by the yard master. Both are under the control of the superintendent.

In the tower, the first man plans the working of the whole plant as far as shipping is concerned, and transmits dispatch orders to the second.

Dispatching.—In the dispatching process, there are several operations:

(1) The required number of wagons is indicated to the yard master. In the gravity yard are six tracks and on the bridge spanning the tracks are six signal lights, one controlling each track. A light signals the wagons on the line indicated to start to the cardumper, and as long as this light is on, wagons are continually sent forward.

This order is given by turning a button on the dispatch board. The numbers on these buttons correspond to the numbers of tracks in the yard. The dispatcher also turns the needle of the car-number indicator B to the point corresponding to the required number of wagons.

After the wagons have started moving, and as they pass under the signal bridge, the needles turn back one after another until all the required cars on the specified track are delivered; at the same time, the light on the signal bridge is extinguished automatically.

(2) To indicate way for loaded pier wagons: When the pier wagons receive coal from the cardumper, the dispatcher turns on the "loaded" signal light. There are four lamps corresponding to four loaders. The pier wagon operator then knows the loader he is to discharge.

(3) To indicate way for empties: When empty wagons return along the central track on the pier, the dispatcher indicates by signal light what the operators must next do, *i.e.*, return to car-dumper, or run up to storage yard for more coal; go to gravity yard to haul loaded wagons direct to pier without using cardumper (which saves coal breakage by dumper), or go to pier siding, to repair shop, and so on.

Each number from 1 to 6 has its special meaning, which is known to the pier operators.

Weighing.—The weigher has no relation to the dispatcher. He prints the weight of coal, which is communicated from the track scales to the dispatching room. Weights are printed on the respective wagon tickets.

The Track Scales.—There are two sets of scales. One weighs the coal discharged by the dumper; the other that from the storage yard. The wagons move at a speed not exceeding 10 kiloms. an hour, as indicated on the scales.

The weighing mechanism is a modification of the Blake-Denison type. The measured weight is transmitted by means of patented mechanical and electrical appliances to the dispatching room, where receiving sets are installed to indicate the respective weights automatically. Aggregate weights are also indicated.

These scales were designed and manufactured by the Moriya Scale Works, Tokyo. The scales have a weighing capacity of 90 tons.

An Improved Cardumper

The cardumper, together with the loaders and pier wagons, was supplied by the Alliance Machine Works, Alliance, Ohio, but has been improved by Japanese engineers. In the original type, the receiving hopper is always stationarily installed before the dumper, and coal breakage is enormous owing to the high drop. In the improved type, the hopper is attached at the top of the turning cradle, and during the turning of the cradle the coal is gradually discharged from the wagon, and slides into the hopper. At the extremity of turning, the hopper end goes into the pier wagon at about one-third of the height of the car-hopper, and at this instant, the hopper gate opens automatically and discharges, thus avoiding breakage to a great degree. This improved design has another merit. As the center of turning is also the center of the weights of the cradle, and wagon on one side, and hopper on the other side, the turning torque of the motor becomes very small, with a consequent great saving of current.

Fushun: A Great Mining Area

A few days after my visit to Fushun, the town was attacked by a large force of bandit-soldiery, when the garrison, and all Japanese who could bear arms, were called up for the defence. There was severe fighting at the pitheads, and one of the mine managers was among the killed. The incident demonstrated the strength and confidence of the bandit forces, for Fushun is now a mining town of nearly a hundred thousand population, and is well policed and protected by the military. The object of the attackers was to destroy the mine machinery, and so work as much damage as possible upon the Japanese; but in this they were effectively frustrated and retreated with heavy loss. Such losses, however, they can bear much better than the Japanese can stand the loss of a tenth of their number. The Chinese source of supply of man-power is unlimited; no sooner are a few hundreds put out of action than others fill the gap, and so the warfare will go on until the Japanese, with the full and vigorous co-operation of the new Government, completely destroy the power that instigates the bandit activities.

Between five and six hundred years ago, Korean emigrants used coal at Fushun, which was exposed on the surface, to fire pottery kilns, but they never made other use of it. On the eve of the Russo-Japanese War, the Russians were mining some 300 tons a day for their railways, but they never attempted to exploit the great deposits on a commercial scale. At one time, the Chinese authorities prohibited mining operations because of the proximity of the mines to the Imperial Mausoleum east of Mukden.

To-day, the Japanese mine some 20,000 tons of coal every twenty-four hours, which represents two-thirds of the capacity of the colliery equipment.

One of the richest fruits of the Russo-Japanese War was the title to the Fushun mines, and as soon as the Japanese secured possession, they set about the work of examination and exploitation with the thoroughness which we have come to associate with them in everything they do in Manchuria. The best brains and the best machinery, native and foreign, were engaged to investigate and analyze and open up, and to-day Fushun coal is exported by the millions of tons to markets abroad in competition with Japanese and Chinese coals.

A great change has taken place at Fushun since a visit I paid ten years ago. A whole town has been shifted in the interval. What is now called the Old Town was giving way at the foundations, it being built over the western deposit and near the underground mines. Promptly, surveyors and builders set to work upon the New Town, in an area where foundations would never be disturbed by operations beneath, and it is hardly necessary to say that the new is much better than the old.

The South Manchuria Railway Company, as in all towns in the railway zone and municipal extraterritorial areas, has imposing central offices, fronted by ornamental gardens, and on the opposite side of the well-paved street, along which runs a tramway, is a large general hospital, the company's property, for the free use of sick and injured. Such institutions are to be found throughout South Manchuria. They are an investment that well repays the company, with its 30,000 Japanese employees and some hundred of thousands of Chinese, workers and dependents, who are concerned directly or indirectly with the railway and the numerous subsidiary enterprises. In such conditions, whatever, the political faults of Japan in Manchuria, it can be stated that the Chinese are much better off under the foreign *régime* than they are under the rule of their own people. Poor the pay may be, and long the hours of labor, as a rule, but these conditions are more than offset by the care taken by the company of workers and their families.

The Open Cut

The feature of Fushun is the now famous Open Cut which is some 50-ft. deeper, much broader, and more regularly terraced than on my previous visit, when it was estimated to be some 250-ft. deep. The coolies at work in the depths look like midgets scooping out a great hole.

The Fushun deposit is classified as of the tertiary period. It is claimed that there is no deposit in the world where so large a quantity of coal is contained in so small an area. This, roughly, is 23 square miles. The length is 10 miles from east to west, and $2\frac{1}{4}$ miles from north to south. The depth averages 130-ft., and the greatest thickness is at the west end, 430-ft., while the slope is 30 deg. The mine area is estimated to have contained 1,000 million tons of coal, of which quantity 100 million tons have been extracted in the past twenty-four years, there remaining an estimated quantity of 600 million tons still recoverable.

The coal is semi-bituminous. The eastern half of the deposit has caking properties, and this coal is used for the manufacture of town gas and coke. The western half is semi-caking, and is used for steam and heating purposes.

Analysis of the coal gives the following contents:—

Moisture	3.9	per cent.
Volatile matter	41.23	,, ,,
Fixed carbon	45.16	,, ,,
Ash	9.71	,, ,,
Nitrogen	1.63	,, ,,
Sulphur	0.66	,, ,,
Calorific value	6,800	calories

Capital Expenditure and Methods of Operation

The South Manchuria Railway Company, Ltd., has invested the sum of Y.123,000,000 (£10,230,000 at par) in the development of these mines, and in subsidiary industries.

The Open Cut is worked by a completely mechanized multiple-bench system. The underground mines are worked by a longwall slicing system in connection with hydraulic sand packing. The output per day aggregates 20,000 tons, half of which comes from the open pit. The record production year was 1929-30, when there were mined 7,300,000 English tons. Since that date, owing to the depression, there has been a steady decrease, and the political upheaval has further prejudiced export, particularly in the China market, where a heavy import duty has been applied to coal from Manchuria, as from an "unknown country," the rate to-day—autumn, 1932—being Y.3 per ton, where formerly it was only 25 sen. This is greatly to the advantage of the company's principal rival in China, the Kailan Mining Administration.

The coal sold in the fiscal year 1929-30, which amounted to 7,991,871 tons (which exceeded the quantity actually produced in that year), was disposed of as follows:—

		Tons.
Exported to:	Japan	1,849,000
	Korea	404,000
	Formosa	10,000
	North China	166,000
	South China	1,101,000
	South Seas *	223,000
Bunker coal:		705,000
Consumed in Manchuria:		
	By S.M.R. Railway	1,402,244
	By railway employees	65,141
	Other consumers	2,024,811

In the year under review, the sale of coal yielded Y.81,379,322; of other minerals, Y.2,985,343. The total receipts were Y.84,364,655, and the expenditure Y.72,089,548, the profit on the year's working being Y.12,275,116.

*South Seas (Nanyo Yumi) are not the groups south of the Equator, but the Philippines, Dutch Indies, etc.

Mine Equipment and Capacity

The mines and their equipment capacity are as follow :—

		Tons daily.
Open pits :	Kojoshi	15,000
	Yangpaipu	2,500
Shaft mines :	Oyama Pit	3,000
	Togo	2,500
Slope mines :	Rokodai	3,500
	Ryuho	3,500
		30,000*

One of the several pamphlets issued in English by the mine management describes former and present methods followed in the working of the mines, the following being an excerpt :—

" As the Fushun coalfield is unique in its thickness, the question as to how to operate it provided a difficult subject for study when the Japanese took it over. The company, under whose management these mines were put in due course, having no experience in mining a thick coal seam and no knowledge as to the quality of coal beds or (what) upper layers there were, began with the pillar-and-stall system. The defect of the system was that a great deal of coal had to be left untouched at the bottom. To make the most of this rich natural resource, therefore, a wiser method—the sand-flushing system—was introduced.

" On the other hand, at the western end of the coalfield, where the top of the coal seam is exposed, or not so deep, the open-cut system was started in 1925. At present there are six collieries at Fushun, producing ever-increasing quantities of coal :

Kojoshi Colliery ..	Kojoshi and Southern Oyama pits
Rokodai	Rokodai and Mandatsuoku pits
Oyama	Main and Southern pits
Ryuho	Shinton, Ryuho, and Toren pits
Togo	Main and Southern pits
Yohakuho	Yohakuho and Higashigaoka pits

" (*a*) *Open Cut System.*—At the west end of the coal seam, where the thick top comes up near the surface, coal is stripped of the covering earth and oil shale by means of the open-cut system. This is a great advantage over the vertical and inclined shafts mining system. By this method such dangers as the explosion of gas in the pit and the collapse of the hanging wall can be avoided, and, what is still better, the coal deposit can be excavated in its entirety. Moreover, mining on the open-cut method is far easier than mining in a sunken pit. The result is an increase in efficiency and a decrease in expenses, as there is no need of mine posts. The amount of production can also be regulated more conveniently according to demand.

" At the Kojoshi Colliery, at the western end of the coalfield, the seam is unusually thick and the top comes near the surface. Here the open-cut method was introduced at one place in 1914, and at another in 1918. It was realized that by using this method on a larger scale a higher degree of efficiency could be obtained. The company, therefore, began to operate on this method on an extensive scale in 1919, extending it more and more until at present more than half the output of the Fushun mines is produced by the open cut.

" In operations, excavators are used to remove the covering earth. Then the upper layer is dynamited, and the pieces are gathered together by means of electric and steam shovels and immediately carried away by rail to the dumping place, or to the shale-oil plant, thus exposing the coal seam. The exposed surface is then shaped into terraces—see illustration. The seam, after being exploded by black powder, is mined by means of electric shovels or manual labor.

" In open-cut mining no skilled labor is needed, as in the case of shaft mining, and Chinese coolies are employed. They number as many as 15,000 per day, turning out an average of 10,000 tons of coal a day at Kojoshi Colliery alone. The open-cut method, which was originally adopted at Kojoshi alone, proved so efficient that it was adopted by pit after pit until, at present, Southern Oyama, Yohakuho, and Higashigaoka collieries are operating by this method on a large scale.

" (*b*) *Vertical and Inclined Shafts.*—The mines are also worked on an extensive scale by shafts or pits, and the coal is then brought to the surface. The method is adopted at four collieries—Oyama, Togo, Rokodai, and Ryuho. The sand-flushing system is now in operation. The shaft, after the coal has been taken out, is filled with earth and sand by means of water pressure. Under the old pillar-and-stall system it was impossible to get more than 20 per cent of the coal deposits. There was also the danger of spontaneous explosion. The new method eliminates this danger, and 70-80 per cent of the deposits can be obtained.

" Earth or sand used for filling is taken from the bed of the Hun River and from the weathered gneiss hills south of the coalfield. It is carried to the flushing ' pocket,' where water is added in the proportion of 100-200 per cent. The mixture is forced, by pressure, through iron pipes to the shaft ready to be packed. The water is pumped out to the surface of the earth when the fillings of sand and earth have settled. Since the establishment of the shale-oil plant, shale waste has also been used for packing."

Dressing Plants

With the extension of the open-cut operations, a dressing plant was established at Kojoshi in September, 1926, at a cost of Y.2,300,000, two years being required for construction. Capacity is 1,000 tons an hour. There is a central dressing plant, and some of the mines are equipped with washing machinery of the Baum type and the Marcus conveyor. After treatment, coal is marketed as lump, of a size over 40 mm. ; nut, 40-25 mm., and dust, under 25 mm.

By-product and Power Plants

Two power plants have a total capacity of 80,000 kw.—one being equipped with the Mond gas producer—see illustration—as well as the Lymn system and by-product recovery process, where low-grade coal is treated, yielding sulphate of ammonia and tar, and producing gas for use in the generation of electric power.

The second power plant has a pulverized coal burner on the Holbeck system, effecting perfect combustion, coal being pulverized to 1/100-in. and used for the generation of electric power.

The power generated by these two plants is used locally for power purposes and lighting, and the surplus is transmitted to towns along the S.M.R., including Mukden. Transmitting capacity is 10,000 kw.

A sulphuric acid plant in which have been installed the Bunkey and Weyer systems, produces 100 tons of chamber acid daily, which is used in the manufacture of sulphate of ammonia, and supplies demand in Manchuria. This plant is being equipped to produce concentrated sulphuric acid.

Thirty ovens of the by-product recovery coke plant, with a coal-washing equipment, which were originally set up to produce 100 tons of coke daily, are now being used for low-temperature distillation of coal, and coalite low-temperature tar, volatile oil, etc., are produced, and the surplus gas supplied as domestic fuel. A tar-distillating furnace, capacity 60 tons daily, produces creosote, pitch, etc. Briquettes are also made in an adjoining plant.

Some 300 kilos. of potassium chlorate are produced daily as material for explosives used in the Open Cut and to meet general demand. Hydrogen to the amount of 52,000 liters daily is produced for the rescue service and for oxyhdrogenl ights.

The Oil Shale Plant

The great oil-shale plant was erected at a cost of a million sterling. The use and disposal of huge reserves of shale, estimated at over 5,000 million tons, had engaged attention for over twenty years, until, in 1928, it was finally decided to make the best use of the deposits, though this course called for a heavy initial outlay. The value of oil to be recovered was not the chief consideration, but this, in a combination with the use of the waste for packing, presented itself as a profitable undertaking, and so it has proved.

The work of construction was completed in November, 1929, the capacity of the plant being 70,000 tons of fuel oil and by-products, ammonium sulphate, crude paraffin, and coke. In the first year of working—1930-31—there were produced 28,578 tons of heavy oil, 10,606 tons of crude paraffin, 13,332 tons of ammonium sulphate, and 2,685 tons of coke. The year's working, contrary to all expectations, yielded a small profit.

There is wide divergence of opinion as to the oil content of the shale, estimates ranging from 2.12 to 10 per cent. Systematic investigation and trials made by diamond borings, sunk through the

*Total equipment capacity daily output.

entire seam, are now held to prove that oil in shale near the surface amounts to 10 per cent, and in shale just over the coal seam less than 5 per cent. The average is placed at 6 per cent, and the final result of many analyses is :

Carbon	12.22 per cent
Hydrogen	1.95 ,, ,,
Nitrogen	0.52 ,, ,,
Sulphur	0.15 ,, ,,
Oxygen	11.06 ,, ,,
Ash	74.10 ,, ,,
Heat value	1,420 calories

Stimulated by these conclusions, a thorough investigation was carried out with a view to the fullest utilization, and samples of the shale were forwarded to Scotland and other countries for expert analyses. The reports obtained are held to have established beyond question the industrial merits of the shale.

Fushun engineers (Messrs. Okamura and Hasegawa) devised and perfected an internal heating system, which, locally, is considered unique. It has been patented by the South Manchuria Railway Company, whose view is that it opens a new field for the oil-shale industry in Manchuria. As a preliminary test, a 10 ton furnace was erected, and results are reported to be satisfactory.

The company, having put this system on a working basis, next prepared plans for the distillation plant, consisting of eighty distilling cylinders each with daily capacity of 50 tons of shale. A crude oil refinery is to be attached. The raw material at present handled amounts to 1,360,000 tons per year, and production is :

	Tons.
Crude oil	69,700
Heavy or fuel oil	53,000
Sulphate of ammonia	18,200
Coke	5,000
Crude paraffin	13,000
Refined white paraffin	7,000

The crude oil is refined in Japan.

Labor at the Mines

The labor union is as yet unknown among the Chinese. The world knows they can unite with destructive effect when the incentive is present, as the boycotts against foreign interests during the past quarter-century amply prove. However, the paternal system prevailing in Manchuria would hardly admit of a union of the men aiming to better their conditions, much less of the labor agitator, and labor politics are, therefore, non-existent. So far, the South Manchuria Railway Company has been fortunate in its experience as the largest employer of labor in Manchuria.

Of the 30,000 Chinese employed at the mines, 70 per cent are from Shantung, and the remainder are Manchuria born. Over two thousand Japanese are employed as mechanics and overseers. The average daily wage of Chinese underground workers is 80 sen (1s. 7d. at par) per eight-hour shift. With the exception of food, workers receive all prime necessities free, viz., they live rent-free, and receive light, fuel, and bath free of charge. Medical and surgical treatment for all in the employ of the company is free, and workers receive full pay while recuperating from injury.

Facilities for recreation are provided, with periodical concerts, and cinema and theatrical entertainments. At a conspicuous place in the colliery quarter is a shrine dedicated to Lao Chun, a Chinese deity.

There is a craft-training school, where those incapacitated from further manual labor are taught to make shoes, hempen ropes, and brooms, the product being purchased by the company.

The Japanese workers occupy the foreman, clerical, and managerial positions, their pay averaging Y.2.50 (5s. at par) per day. Retirement allowance are given to both Japanese and Chinese workers, from coolie to superintendent—a practice common among all workers in Japan.

The Fushun undertakings are under the general superintendence of Vice-Admiral Dr. Takuo Godo (Ret.), former Director of the Naval Arsenal at Kure. The chief engineer is Mr. T. Kubo.

Admiral Godo is also Superintendent of the Anshan Ironworks and Mines, and President of the newly formed Showa Steel Works. The steel works are still in the formative stage, and the site has not yet been decided. This is a great national undertaking which has received the approval of the Government and the Diet, and only financial stringency has prevented its earlier establishment.

The population of Fushun has expanded considerably during the past decade, and is now estimated at something in excess of the following figures :—Japanese, 18,000 ; Chinese, 70,000 ; Koreans, 3,000. There are a few Russians, and one at least who works in the mines, receiving the same pay as the Chinese miner.

The small Occidental population is represented by the priests and nuns of the Roman Catholic Mission. In September, the diocese of Mukden was divided into two, and Fushun is the center of a new diocese, which includes large areas of Mukden and Kirin provinces. While the old diocese remains in charge of French priests, the new has been taken over by American priests from the Jesuit Seminary at Ossining, N.Y.

A minor industry of Fushun is the working of amber recovered from the coal. This is in the hands of Chinese craftsmen.

High Pressure Turbine Plant for Russia

One of the most interesting stations built in connection with the comprehensive electrification schemes of the U.S.S.R. is that of the Thermo Technical Institute of Moscow. In this station very high thermal efficiency is expected from the installation of high pressure Loeffler boilers supplying one or more primary turbines which in turn will exhaust to the existing steam system at 384 lb. sq. in. abs., the scheme to some extent following that adopted in the Billingham Plant of the Imperial Chemical Industries but employing considerably high steam conditions.

The first primary turbine unit which is being built in this Country by Metropolitan-Vickers Electrical Co. of Manchester is designed to operate normally with steam at a pressure of 1,778 lb. sq. in. abs., superheated to 878 deg. F., and to exhaust at a pressure of 384 lb. sq. in. abs., actually it is designed to withstand continuously a temperature of 932 deg. F. and for short periods a steam temperature of 968 deg. F. The unit will be of 24,000 kw. maximum continuous rating, running at 3,000 r.p.m. and will be coupled to an alternator which is being built in Russia.

In order to view this unit in its true perspective it should be appreciated that it deals with the same steam quantity as that of a condensing unit of about 84,000 kw. output built for and operating under similar high initial conditions, its actual steam consumption being of the order of 300 tons per hour. It will be, in fact, the largest unit yet built for what might be termed extra high pressures, i.e. pressures over say 1,000 lb. sq. in. g.

The actual design of the turbine cylinder follows to some extent that adopted for the three primary turbines built by Metropolitan-Vickers for the Billingham Station. It will be recalled that these units which are each of 12,500 kw. capacity, running at 2,400 r.p.m. were designed for initial conditions of 630 lb. sq. in. abs. superheated to 833 deg. F. exhausting at 275 sq. in. g. and have now been in commercial service for over three years.

Speed governing is adopted but means are incorporated in the governing system for automatically maintaining the turbine exhaust pressure within certain limits by the transfer of load to or from condensing units in the station. Two steam chests are provided one at either side of the cylinder as in the case of the Billingham plant, each chest containing four admission valves. There are thus eight steam connections, each of relatively small diameter, to the cylinder itself, which facilitates the provision of the necessary degree of flexibility for expansion.

In the design of the turbine and in the choice of materials to meet the high steam conditions full advantage has been taken by the Metropolitan-Vickers Co. of the most recent researches carried out in their Research laboratories into creep of metals at elevated temperatures and associated problems. In many respects this turbine represents a considerable advance in the technique of power generation and its operating results will be awaited with great interest by engineers throughout the world.

considerable saving in labor in boiler room staff, the easy and speedy adjustment of fire against the fluctuation of load, the easy starting and stopping of fire which unnecessitates burying fire, a small capacity of fan owing to a small excess quantity of air, the complete combustion with very light yellow smoke almost colorless—except at the beginning of firing, etc.

A slight trouble in falling of fine particles of ash from the funnel on deck has been experienced in these ships, but this is not at all a serious matter in cargo vessels and even in these passenger steamers a higher funnel or adoption of a suitably designed deflector at the top of the funnel can easily overcome this minor trouble.

Further, the writer trusts that after a long run the boilers will show a longer life owing to no entrance of cold air to the furnaces due to the lack of necessity of opening the furnace fronts for firing, whilst the uniform steam pressure and consequent steady speed of the ships will reduce days of navigation.

As to the disadvantages of the pulverized fuel burning plant, an increase of machinery weight by some 5 per cent and an extension in some parts of the boiler room by about 5 to 9 feet have been taken into account. The writer, however, believes that these disadvantages will be cancelled with the reduction of fuel quantity to be carried and the consequent reduction of bunker capacity and space, whilst in new ships a certain reduction of the tonnage can even be expected.

There is, however, still ample scope for the further development and improvement of the existing systems, particularly in dealing with ash in boiler, etc., and the writer hopes the builders and engineers will put forth their best endeavors for further improvements.

A Remote Lighting Plant in China, Near Tibet

(Continued from page 283)

"When climbing the stiff passes, the whole 16 men were around the dynamo like gamblers around the dice and when on a narrow ledge, the men were stretched out in a single file. The adjustment of the carrying apparatus was most ingenious. In some places the road had completely disappeared, being washed away by the undercurrent of water; in other places precarious bridges had to be carefully manipulated. Two very steep passes had to be crossed, heavily covered with snow and ice.

"At present the city is not completely lighted through some mistake in the reordering of material thrown into the Yangtze. When the steamer carrying the electric plant for Tachienlu ran on a sand bank above Hankow the machinery was thrown into the river, because bandits hanging around threatened to attack the ship. When the new order started again from Shanghai, it was not discovered till the boxes arrived here, that there was not enough wire to go around the town. A Tachienlu musk merchant, interested in the lighting of the city, arrived with his musk in Shanghai some time in January. His plan was to sell the musk and secure the necessary additional wire but civilized Shanghai became too dangerous for the merchant, so without the wire, he beat a hasty retreat to safety in the wild borders of Tibet.

"When the city is completely lighted, the populace—Chinese and Tibetans, ought to be very grateful to those who have put through this most difficult undertaking."

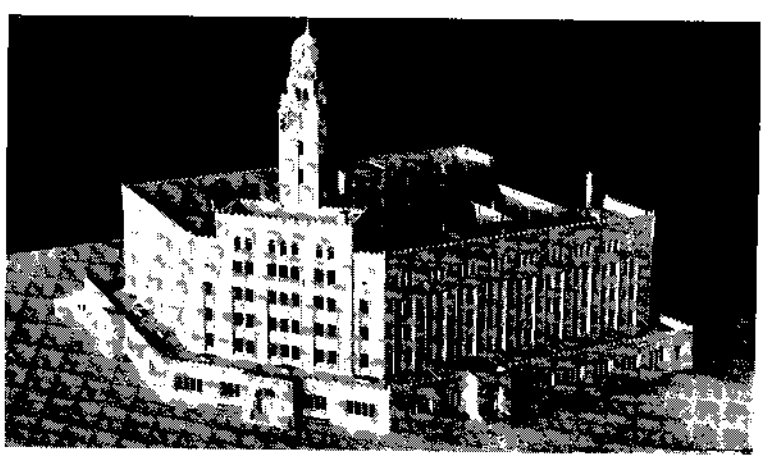
Railway Schemes in Shansi

There is talk of an early start being made in railway enterprise in Shansi province, China, and apparently it has been decided to make the Tung Pu line of meter gauge to avoid transhipment of goods coming in on the Chengtai line, and to use rails having a weight of 35 lb. per yard, approximately. On purely theoretical grounds a good deal of criticism has been directed against the proposal, but there can be no doubt that a line of 2-ft. 6-in. gauge running north and south would meet all traffic requirements for many years. Consequently the sponsors of the project consider it unreasonable to deprive the province of a much-needed line until it is in a financial position to construct one of standard gauge. Such a line would give a large saving in capital cost over one of standard gauge, due to the small radius curves and flexibility of alignment obtainable, and which would enable it to follow land contours, thereby avoiding heavy embankments and deep cuttings. Earthwork would be largely half excavation and half embankment, and much lighter bridges could be used. The proportion between dead and paying loads also favors the light railway. The decision to use the meter gauge will result in the new line linking up with the Chengtai line which runs into the center of the province. Marshal Yen is also contemplating the setting up of furnaces and rolling mills for the production of steel rails from Shansi ores.

Yokohama's New Customs House

For several years past, adequate facilities for customs house accommodations at Yokohama have been needed to replace temporary quarters put up hastily subsequent to the 1923 earthquake, which laid waste this important port city of Japan. It was only recently that the Ministry for Home Affairs of the Japanese government, by providing the necessary appropriations, made it possible to erect an appropriate office structure for a new Yokohama Customs House.

Including the foundation, the building now under construction will cost approximately Y.1,171,596, cover a ground area of 6,875 sq. meters and have a floor space of 12,183 sq. meters for its five stories reaching 22.36 meters from the level of the ground to the parapet, the Imperial Finance Department reports. Topped by a turreted, dome-crested tower superimposed over the building's forepart, the entire structure will rise to a total height of 51 meters above the sidewalk.



Model view of new Customs House now under construction for Port of Yokohama at total cost of Y1,171,596 for building and foundation. Work began September, 1932 and completion scheduled by March, 1934. Builders, Todan-Gumi, Ltd.

In an effort to have the new customs offices ready for occupancy according to schedule by March, 1934, the contracting firm of Todan-Gumi, Ltd. has made steady headway with the building itself, which was begun in January of this year. Plans designed at the Government Architectural Bureau in Tokyo are being followed. In December, 1932, work on the concrete-pile foundation, for which ground was broken three months previously in September, had been completed. This foundation alone cost Y.48,096.

Ferro-concrete, earthquake resisting construction is being employed throughout the new Yokohama Customs House. Heavy framework of structural Yawata steel encased by reinforced concrete will be covered with white facing brick when the building is finished.

ENGINEERING FINANCE

THE FAR EASTERN REVIEW

上海黃浦灘念四號

遠東時報

THE STORY OF A REVOLT

THE CASE FOR MANCHOUKUO

THE PROBLEMS OF THE DAY—
AND THEIR SOLUTION

Vol. XXIX | JULY, 1933 | No. 7

The Nanking-Pukow Train Ferry

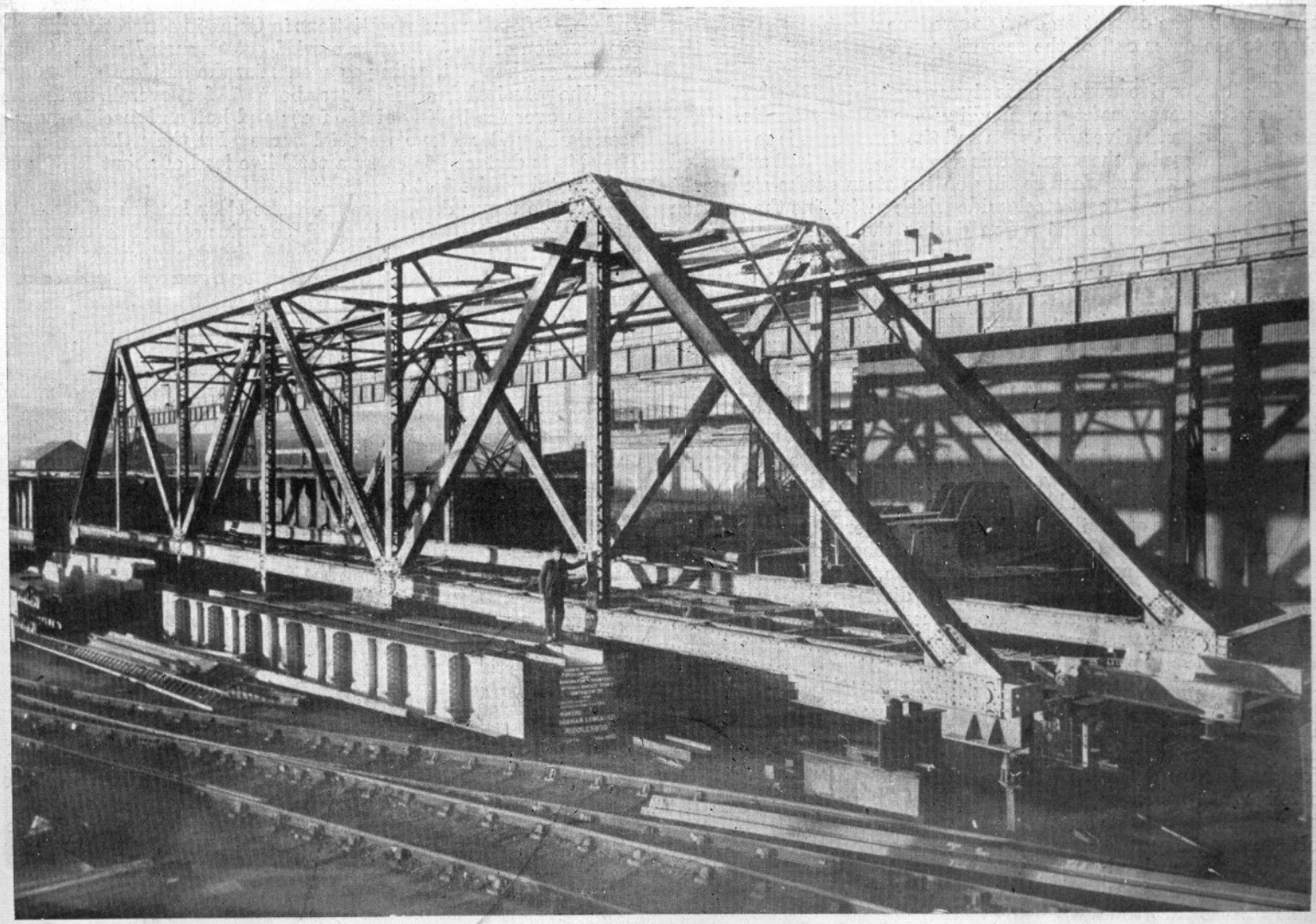
Project to Span the Yangtze River Includes Building of Bridge Approaches to Serve in Conjunction with Specially Constructed Steamer

THE project to establish a train ferry service across the Yangtze River connecting Nanking and Pukow and being carried out under contracts made through the London Boxer Funds Purchasing Commission, will be brought into realization in coming months. The train ferry, built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., has arrived in China, and the bridge approaches, including steelwork and machinery, are to be transported to China shortly. The negotiations in China for these were conducted by Messrs. Arnhold & Co., Ltd. acting in conjunction with Messrs. A. Cameron & Co. (China), Ltd., agents for Messrs. Dorman, Long. In connection with these contracts Sir Alexander Gibb and Partners are acting as consulting engineers and the steelwork is being rolled and fabricated by Messrs. Dorman, Long & Co., Ltd. at Middlesbrough. The machinery and electrical equipment are being supplied by Messrs. Thomas Broadbent & Sons, Ltd., who have recently joined the group of firms comprised in Messrs. Dorman, Long & Associates (China), Ltd. The foundations and the erection of the steel bridgework are being carried out by the Chinese Government Railways.

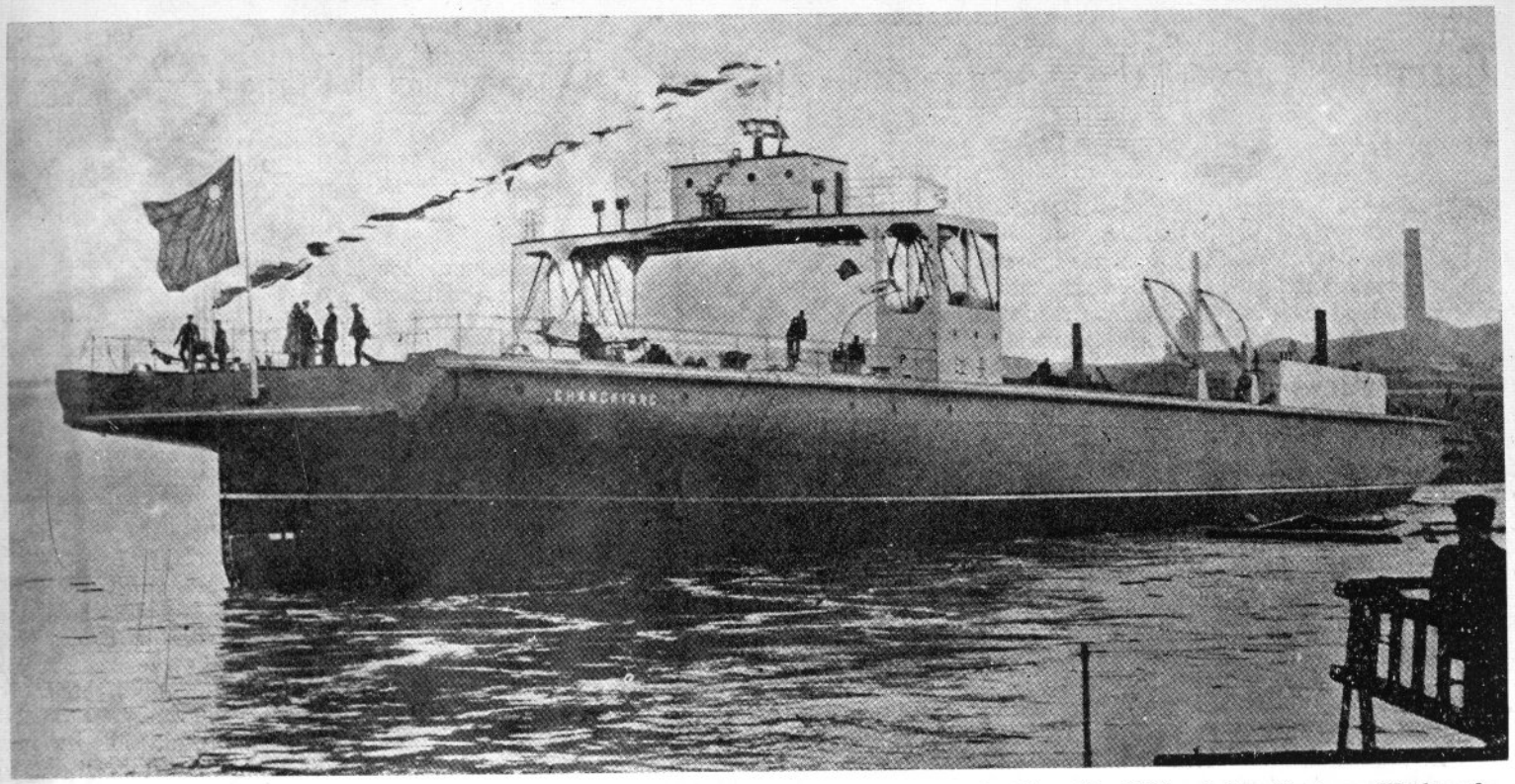
With regard to the arrival in China of the train ferry *Changkiang* some time ahead of the arrival of the bridge approaches and steelwork it is to be explained that the contractors' drawings for these were not given official approval until October, 1932, whereas the contract for the ferry steamer was signed seven months earlier. Actually, Messrs. Dorman, Long's deliveries of the bridgework are being made ahead of contract time.

The photograph below, taken at the Middlesbrough works of Messrs. Dorman, Long & Co., Ltd., where the bridgework is being fabricated shows one of the movable spans for the bridge terminals of the train ferry. The object of this undertaking is to carry freight and passenger trains across the Yangtze River, the bridge approaches giving access to the ferry steamer having to make provision for a maximum variation of 25 feet in the water level during the year and for daily variations due to rise and fall of tide of between one and three feet. The bridge approaches are identical on each side of the river. The bridge consists of three spans of 154 feet and one of 152 feet and in the following description these are referred to as Nos. 1, 2, 3 and 4 from river to shore.

Spans 2, 3 and 4 are 20 feet wide center to center of trusses while No. 1 flares out to 44 feet. A single railway track is carried at the shore end, which branches out on span No. 1 into three, providing for shunting trucks on to the three tracks on the ferry boat. The fourth, or shore span, is hinged at its shore end, while its outer end is connected by pin joints to the inner end of the third span. These pins also carry links and large nuts in which a screw rotates. The junctions between each span are provided with similar nuts, pins and screws, as in the outer end of span No. 1. Two screws, one at each side of the bridge, are carried on a steel tower at each



One of the movable spans for the bridge terminals of the Nanking-Pukow Train Ferry being fabricated at the Middlesbrough Works of Messrs. Dorman, Long & Co., Ltd.



The Train Ferry steamer "Changkiang" at it took the water at Newcastle-on-Tyne, October 12, 1932, at the Neptune Works of Messrs. Swan, Hunter and Wigham Richardson, Ltd.

pier and are electrically driven through suitable gearing so that the fourth, third and second spans may be raised or lowered simultaneously by the correct amount to produce a uniform slope from shore to the outer end of the second span to suit the level of the water.

The first, or riverward, span is always maintained in a horizontal position for greater safety in handling the railway traffic. Connection between the riverward span and the ferry boat is made by a steel apron hinged to the span. This apron may be raised or lowered by electrical gear and when resting on the stern of the steamer it engages with a heavy cast steel guide which maintains the position of the boat relative to the apron during the loading operation. The hinged apron takes up any difference in level in the ferry boat when loading, and hinged and sliding rail joints connect railway tracks on the apron and on the boat.

All the machinery is electrically interlocked so that the operator can only carry out the various operations on the correct order. Thus he will first adjust the bridge to the correct level and lower the apron on the steamer. Until the apron is correctly locked in position on its guide, the barrier gate across the end of the span cannot be raised to allow the trucks to be run off the bridge. In the event of the ferry boat moving away while the barrier gate is open, it will close automatically, a warning gong sounding the whole time the gate is closing. Hand operating gear is arranged for all the machinery in case of a failure of the electric power.

The train ferry *Changkiang* was launched on October 12 last from the Neptune Works of Messrs. Swan, Hunter and Wigham Richardson, Ltd. in the presence of a distinguished gathering. Madame Quo Tai-chi, wife of the Chinese Minister in London, christened the vessel as it left the ways. The *Changkiang*, which arrived in Shanghai last May, is a twin-screw vessel designed for the transportation of freight and passenger trains and is capable of transporting 21 passenger cars simultaneously, making possible for the first time through railway traffic linking Shanghai and Peiping. The work of building the vessel and its propelling machinery was carried out under the supervision of Sir John H. Biles and Co. of London and negotiations in China in connection with the construction of the ferry were carried out through Messrs. Malcolm and Co. of Shanghai, acting as agents for the builders *

The principal dimensions are about 372 feet overall, an extreme breadth over the belting of 58½ feet ; and hull and machinery have been built under Lloyd's special survey for their Class 100 A.1. The ship is designed to carry a total live load of about 1,200 tons, and a total deadweight of 1,550 tons.

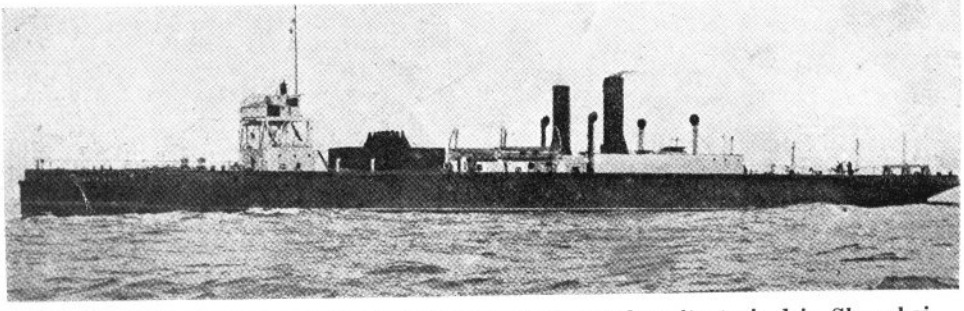
On the upper deck there are three clear lengths of car track, each 300 feet long, taking in all three trains each of seven wagons. The cars will be shipped from the forward end, the connection between the shore and the ship being made by an approach bridge of four spans about 20 feet wide between the trusses, and widening out on the deck of the ship.

The operation of leading the wagons will be by a shunting locomotive carried on the ferry at the after end of the upper deck, working in conjunction with traversing gear by means of which the locomotive may be moved horizontally across the deck to enable it to operate on any of the three lines of rails. At the after end of this deck and in line with each car track, substantially supported buffers were built.

The forward end of the upper deck is recessed in an athwartship direction to receive the apron, which in its working position will be flush with the upper deck, connecting the railway track on the shore w th the three lines of track on the deck of the ferry. To facilitate berthing there is, in addition to the after steering arrangements, a bow rudder with its independent steam steering gear for use in manoeuvring in and out of the berthed positions.

The propelling machinery is amidships with the casings arranged at the sides of the upper deck, and a coal bunker is provided in a recess between the two boilers. The

(*Continued on page 335*)



The Train Ferry steamer "Changkiang" as it appeared on its arrival in Shanghai in May, 1933

**Far Eastern Review*, June, 1932

Engineering Notes

INDUSTRIAL

CANNING.—Sardine fishing companies in the Japanese half of Saghalien have decided to establish the Karafuto Joint Fishery Company with a capital of Y.5,000,000.

NEW FLOUR MILL. The Masuda Wheat Flour Mills Company of Kobe has decided to build a new mill at Koyasu in Kanagawa Prefecture. The new mill will have a daily capacity of 500 barrels, and is expected to be completed in August. The site covers 3,000 tsubo.

SPINNING MILL FOR TSINGTAO.—A spinning company is to be organized in Tsingtao by the Toyoda Spinning Company, Shanghai, and the Nikkwa Silk Company in Shantung, associated with the Katakura Silk Reeling Company. The proposed concern will be capitalized at Y.3,000,000.

MANCHURIAN FORESTS—Mr. Fusajiro Abe, president of the Toyo Spinning Company of Japan, has decided to get into Manchurian forest development. His plan includes a large pulp company under joing Japan-Chinese management. The Oji Paper Company and rayon companies would be asked to take shares.

ARMAMENT DEPOT FOR HONGKONG.—Hongkong arsenal yard having been surrendered to the Colonial Government, a new armament depot is being provided at Stonecutters Island at a cost of £175,000, of which £40,000 is set down in this year's naval estimates. Similarly, in lieu of the existing hospital buildings, which are to be purchased by the Colonial Government, to which the site belongs, a new naval hospital is being erected at an estimated cost of £132,000, though only £8,735 toward it is yet voted.

AVIATION

SINGAPORE AIRPORT—Singapore is to have a thoroughly modern airport which will be one of the most costly in the world. It will cost $3,500,000, will take more than four years to build and some 8,000,000 tons of earth will have to be filled in on the site which, at present, is a swamp.

PLANES FOR CHINA—A campaign to raise $2,000,000 for the purchase of 150 aeroplanes for the Government will be launched to-day by the China National Aviation Association, and is to last two months. More than 200 prominent merchants, residents and bankers are busily organizing teams to canvass for new members for the Association. The members'hip fees derived from them will all be deposited in Chinese banks until the conclusion of the campaign.

SHANGHAI-TIENTSIN AIRWAY.—It is announced that formal inauguration of the Shanghai-Tientsin Airway, to be operated by the China National Aviation Corporation, will take place on New Year's Day. Many difficulties were encountered in connection with landing fields and other facilities, but these have been overcome. The Corporation has succeeded in acquiring a lease of the Tsingtao landing-field by payment of $20,000 to the Japanese lessees. Upon inauguration of the service planes will take off from each terminal three times a week, carrying passengers and mails. The tentative schedule is as follows: Leave Shanghai, 7.45 a.m.; Haichow, 10.55 a.m.; Tsingtao, 12.30 p.m.; arrive Tientsin, 3.30 p.m. Leave Tientsin, 8 a.m.; Tsingtao, 11.15 a.m.; Haichow, 12.45 p.m.; arrive Shanghai, 3.45 p.m. The journey will be accomplished in about seven and a half hours, covering a distance of approximately 690 miles, and the trip will cost $120.

COMMUNICATIONS

CHINA: DIRECT WIRELESS.—Negotiations have been concluded for a direct wireless service between London and Shanghai, which, it is hoped, will be in operation towards the end of this summer. The Shanghai installation, which is being supplied by Great Britain, will be financed from the proceeds of the Boxer Indemnity Fund, and it is believed that the first portion of the machinery is already on its way to China.

BOXER FUND LOANS.—The Board of Trustees of the Sino-British Indemnity Fund decided to advance £4,500,000 to the Ministry of Railways for the construction of the Canton-Hankow Railway, and £360,000 to the China Merchants Steamship Company to have six ships built in Britain. These two loans, which represent approximately $80,000,000, will be the biggest advance ever made to the Chinese authorities by the Board, which is also considering favorably further loans for educational and communication purposes.

CHRISTMAS ISLAND WIRELESS.—The Christmas Island Phosphate Company has for some time past maintained a small wireless station, which is being extended and modernized by the provision of two Marconi stations for direct communication with Singapore and with distant ships. The link with Singapore is by short-wave, utilizing a "Type S250" transmitter covering the waveband of 20 to 100 meters, with a power to the aerial of 250-W when operating continuous wave telegraphy, for which it is particularly designed. For working with ships on medium wavelengths, a special 200-W transmitter has been supplied. Christmas Island is 800 miles south of Singapore in the Indian Ocean.

MINING

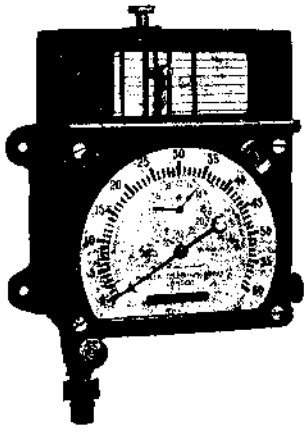
FORMOSAN GOLD.—The Mitsubishi Mining Company, largest gold producer in Japan, is to undertake placer gold development at Tatsukiri River ravine in eastern Formosa at the invitation of the Formosan Government-General. The property is rather inaccessible and will call for heavy capital outlays on communications. The Government-General, it is reported, picked Mitsubishi because of its financial resources and its experience of placer mining in Kintei, Korea. For some months Mitsubishi engineers have been surveying the Tatsukiri property. Technically the enterprise is difficult because of immense stones in the river bed and the fact that the river is in a district peopled by head hunters.

COAL MINING IN FUKIEN.—Prominent Chinese are promoting a mining corporation with two million dollars capital, for developing the Fukien's rich coal deposits. While prospecting for tin at Yungchun they discovered in the Tienhushan mountains a very promising coal deposit, estimated to contain 1,800,000,000 tons of high-grade anthracite. Another promising coal field west of the Tienhushan Mountains, also high-grade anthracite, has yet to the investigated. The problem of transport from this mountainous area has been studied. Connection between Yungchun and Anki, and between the Tienhushan Mountains and Hutou, in each case a distance of 20 *li*, may be effected by light railroads. From Hutou coal can be transported by water. It is estimated that the railroad, together with rolling stock and a 5 ton locomotive, would cost approximately $200,000. The cost of a steamer with a fleet of lighters is estimated at $200,000.

ELECTRICAL

POWER STATION SCHEME.—The Naragagawa Electric-Chemical Company, affiliated with the Toho Electic Power Company of Japan, has decided to erect a power station at Uchigaya on the Nagara River. The proposed station will generate 40,000 kw. Expenses for the station are estimated at Y.4,600,000, inclusive of transmission lines. Work is expected to start in September this year to be finished in two full years.

KOREAN HYDRO-ELECTRIC DEVELOPMENT.—Thirty-five applications have been received by the Korean Government for permission to establish hydro-electric undertakings in Korea. The most important are those of the Korean Electric Industrial Co. (capital £3,000,000), the Korean Electric Power Co. (£5,000,000), the Korean Nitrogenous Manure Co. (£5,000,000), the Seoul Electric Co. (£1,900,000), the Korean Railway Co. (£1,720,000), and the Korean Central Hydro-Electric Co. (£1,000,000).



THE BEST LOCOMOTIVE SPEED INDICATORS & RECORDERS

WITH CONJUGATE MOVEMENT

TELOC TYPE

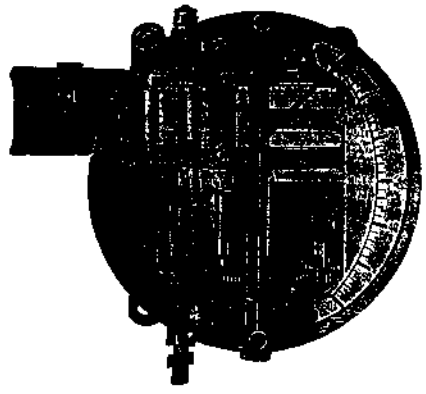
Chart Feed on a Mileage Basis of 10 m/m per Mile.

INDICATES:—Speed.
Total mileage since application of Instrument.
Total mileage of each run.
Time of Day in Hours and Minutes.
RECORDS BY SILVER STYLUS:—Speed attained at any point of run.
Time the engine or coach is at work.
Distance covered.
Duration (up to 24 hours) and point of stops.
Time of Day in Hours and Minutes.
If desired apparatus to record working of Westinghouse or Vacuum Brakes.

HASLER TYPE

Chart Feed on a Time Basis of 4 m/m per Minute.

INDICATES:—Speed.
RECORDS BY NEEDLE PUNCTURES:—Speed attained at any point of the run.
Time the engine or coach is at work.
Distance covered.
Duration and point of stops.
If desired bell can be fitted to ring at predetermined speed, or apparatus to record working of Westinghouse or Vacuum Brakes.



HASLER TELEGRAPH WORKS, 26 VICTORIA STREET, LONDON, S.W. 1

ENGINEERING FINANCE COMMERCE

THE FAR EASTERN REVIEW

RECEIVED
OCT 4 1933
AUTOMOTIVE DIVISION

上海黃浦灘念四號

遠東時報

MORE LIGHT

THE WILL OF THE PEOPLE OF MANCHOUKUO

THE LEAGUE'S TASK

THE OUTLOOK IN CHINA

THE CHINESE COTTON INDUSTRY

Vol. XXIX AUGUST, 1933 No. 8

the opening of the underground line last May. Yodoyabashi, Honmachi and Shinsaibashi each have stations equipped with island platforms with the tracks running on both sides.

Brick in mastic or asphalt fabric for waterproofing is laid on the outside of the tunnel structure. With 15 meter, P.S. type rails weighing 100 pounds per yard, the standard gage of 4-ft. 8½-in. (56½-in.) in track width was adopted. At joints, spot-welding joins four rails together end to end, and these rail sections are fixed to the sleepers by means of screw spikes.

Broken stone ballast reinforces the track bed within the tunnel proper, while concrete imbeds the rails at stations. Long sleepers are laid for rock-ballasted trackage, and these wooden sleepers are all treated with creosote. Short concrete blocks hold rails where the bed is concrete.

Other Details of System

Underground signals consist of three-color lights in conjunction with an automatic train stopper. The operation of inter-locking switches at crossovers is effected by means of an electro-pneumatic mechanism.

To transmit electric power within the tunnel, a third-rail upper contact system is used, with the lines weighing 150 pounds per yard, and carrying 750-volts D.C.

All subway coaches are made of steel and measure 17 meters in length, with a weight of 43 tons. They have twin motors of 230 h.p. and are equipped with dynamic as well as air breaks, automatic coupling devices and doors operated pneumatically. Each passenger car is built to accommodate 120 persons with ease.

At and between stations exhaust as well as blow fans, each having a 200,000 cu. meter capacity per hour, are installed in case of necessity.

Ceilings and walls along station passages, mezzanines and platforms are lit by electric lights with especially decorated shading fixtures. At intervals between stations, the tunnel is illuminated by electric lamps, and in the event of temporary current breakage, storage batteries are provided to light stations and tunnel sections.

Electric Substation.—At Umeda a substation takes 22,000-volts a.c. from two different sources, and provides two sets of 2,000 kw. rotary converters, transformers, etc.

Trains run on a regular schedule of every three minutes, and a flat fare of 10 sen is charged. Ever since the subway was opened last May, turnstiles have been in experimental use at some of the stations.

Owing to the fact that the initial underground link was laid in the busy downtown district of Osaka, there is no available site on the ground surface along the route of the subway upon which to locate carsheds. It is interesting to note, for this reason, that necessity compelled the coaches to be lowered onto the subway tracks by derrick suspension from the roadway above, and to make use of a part of the underground station and adjoining space for a repair shop as well as car depot. Later these depots and repair shops will be provided for along elevated lines in the suburbs of the city.

Construction costs of the present completed subway section, including cars, electric substations and other equipment, is approximately Y.11,200,000 or Y.3,700,000 for each kilometer in operation.

The opening this year of Osaka's subway line commemorates the 30th anniversary of the municipal street railway. On May 30, the municipality of Osaka celebrated both of these events—and even a subway march and a sonnet were composed for the occasion.

Principal city officials responsible for construction of the Osaka Rapid Transit Railway are: Dr. H. Seki, Mayor; Y. Hiratsuka, Director of the Electric Bureau; H. Shimidzu, Chief of Department of Transportation; K. Hashimoto, Chief of Construction Division; C. Aoki, Chief of Electric Division, and T. Kikukawa, Chief Engineer of the Municipal Electric Bureau.

New Railway Station for Shanghai

Elaborate plans have been drafted for construction of the new railway station to accommodate the headquarters of the Shanghai-Nanking and Shanghai-Hangchow Railway Administration in place of the North Station which was partially destroyed by Japanese bombardment during the Sino-Japanese hostilities in Shanghai.

Construction on the scale now being mapped out will call for the total of $10,000,000. A vast piece of land situated near the railway station at Chenju has been chosen as site for the new station. This lot of ground is more than 3,000 feet long from south to north and more than 10,000 feet long from the intersecting point of the Shanghai-Nanking and Shanghai-Hangchow lines on the east to the Chenju Station on the west.

When construction work starts, it may be necessary to make arrangements for the removal of grass huts and other cottages found within the area. Negotiations are now proceeding for the purchase of all the lands within the mapped-out area from the villagers by the railways administration.

During the first stage of work, the main building to accommodate all the departments of the Railway Administration, the station platform and other offices will be built. Construction to increase the railway tracks, to build a small railway workshop and to enlarge the godown at Markham Road will be carried out. The funds required for the completion of all this preliminary construction are estimated to be around $7,000,000.

Plans have also been made for the removal of the central railway factory where all important repairs to locomotives and construction of engine parts are made from Wentsaopang to the new central railway station at Chenju. The construction of this factory will be proceeded with slowly and in so far as the business income of the railways affords.

A large part of the funds required for the preliminary construction for the new central railway station, according to a responsible official of the Shanghai-Nanking and Shanghai-Hangchow Railway Administration, is now already available. To fill the gap, he said, it may be necessary for the administration to secure a loan from foreign sources.

Construction Activities in Singapore

By Assistant U.S. Trade Commissioner DONALD W. SMITH

Although Singapore, in common with other important world cities, is suffering from the throes of the present economic depression, a number of important government and private building projects are under way. American firms, however, are barred almost automatically from bidding on materials or equipment for any government construction work, as a result of the policy of the Straits Settlements Government of buying only British products.

The 1932 budgets of the Straits Settlements Government provide a sum of S$8,099,340 for government construction work in Singapore during the year. Of this amount, S$800,000 is being expended on a new prison, which is expected to cost S$2,050,000 before completion; S$300,000 on the S$2,200,000 Teluk Ayer Basin project, which calls for the dredging and construction of quay walls along the sea front; and S$200,000 on the reclamation scheme to reclaim land between the Singapore and Rochore Rivers.

Another important government undertaking that is nearing completion is the new Johnston's Pier, which is being built in the busiest section of Singapore's water front at a cost of S$468,000.

Other government projects recently completed or nearing completion involve an expenditure of S$2,523,000 and include the following: Buildings for Monopolies department, S$300,000; detective station and quarters, S$500,000; barracks for Sikh policemen, S$630,000; police barracks, S$458,000; reconstruction of the central police station, S$215,000; and a new government printing office, S$420,000. During the first quarter of 1932, the Straits Settlements awarded contracts amounting to S$98,080 to private firms in Singapore for minor projects.

Private building and construction work has fallen off considerably in Singapore during the past few years, but at the present time several important projects are under way involving a total of S$2,570,000; the largest of these is the new grandstand, race-course and stables being built for the Singapore Turf Club at a cost of approximately S$1,750,000. Two modern breweries have been erected at a total cost of S$470,000.

ENGINEERING FINANCE COMMERCE

THE FAR EASTERN REVIEW

上海黃浦灘念四號

遠東時報

ON THE SUBJECT OF MANCHOUKUO

THE NEW DEAL IN THE PACIFIC

MANCHOUKUO, ONE YEAR OF ACHIEVEMENT

Vol. XXIX | SEPTEMBER, 1933 | No. 9

Modern Traction in Siam and Manchuria*

With Diesel Locomotives

A SPECIAL number of the *Sulzer Technical Review* is mainly devoted to the Sulzer Diesel locomotive for express and good strains and shunting purposes, and to the Diesel electric rail car. In this connection the acquisitions in recent years of the Royal State Railways of Siam and of the South Manchurian Railway receive special attention.

Diesel traction has long passed the experimental stage, and in the last five or six years has been successfully adopted in many countries and by some on a large scale. Hitherto, economical and technical conditions have had much to do with limiting the adoption of Diesel locomotives to special cases. Owing, however, to the progress in engine design and construction the technical difficulties have been overcome, and as to whether steam, Diesel or electric traction is the most economical, there are a number of cases where Diesel is obviously favored by special circumstances. This holds especially in cases where water is scarce and in others where fuel has to be transported for long distances. In consequence of the low fuel consumption and the ease of transporting oil fuel, Diesel locomotives are in such cases essentially the more rational. Another particularly favorable case for Diesel traction is on so-called strategic railways.

The most important forms in which Diesel-engine traction has been adopted so far are for (*a*) shunting locomotives, (*b*) rail cars and locomotives for light railways or for branch lines, and (*c*) locomotives of medium power for main railways.

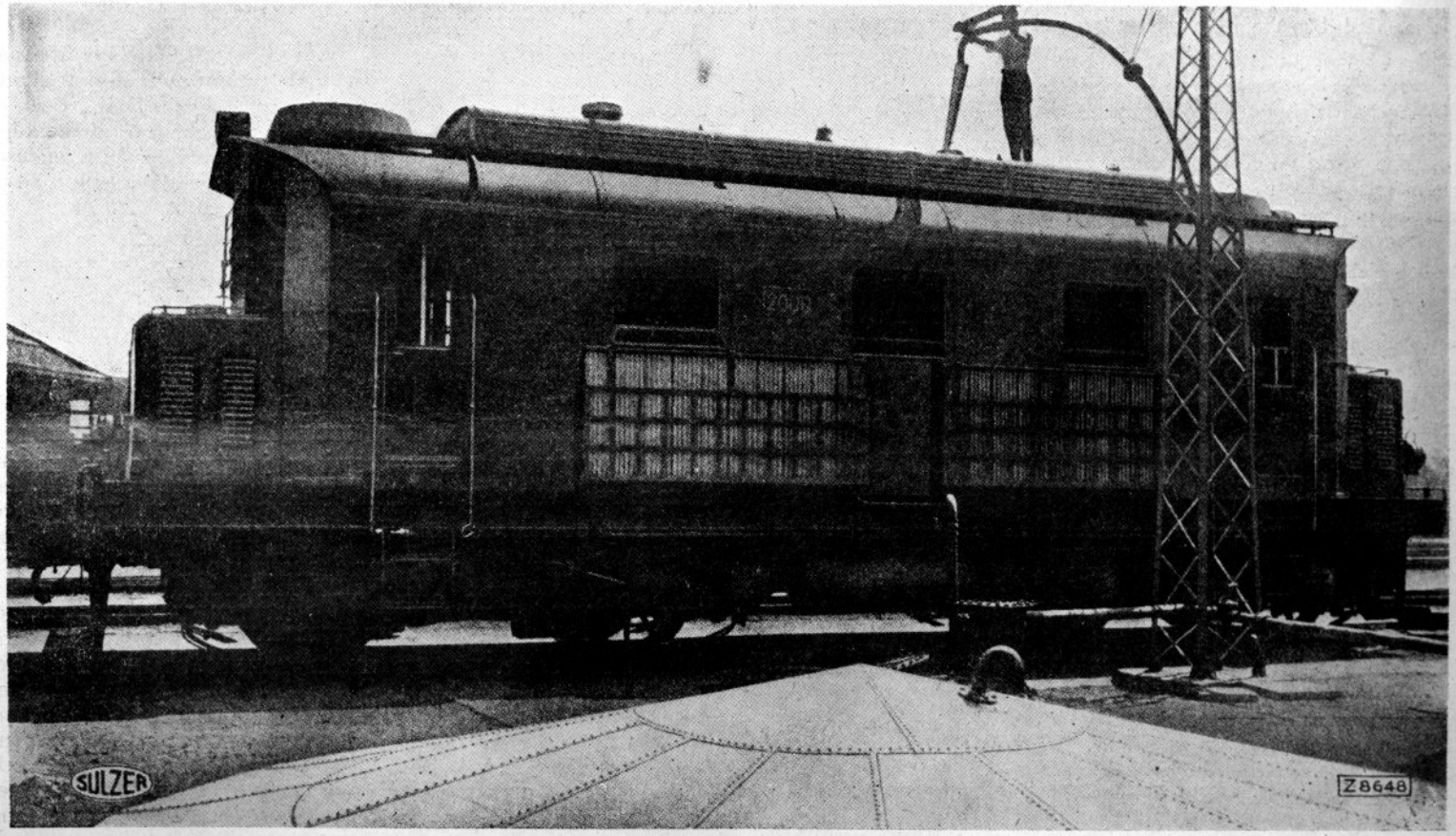
In the Far East the South Manchuria Railway has adopted the 750-1,000 h.p. Diesel engine for use in the first category, and Siam locomotives of from 450 to 900 h.p., the former for light passenger and goods traffic, and for shunting. The higher powered locomotives are for express trains of the Royal State Railways, whilst for heavy goods trains an experimental Diesel locomotive is being used. In the *Railway Gazette* of May 20, last year, the case was mentioned of one of these Diesel locomotives replacing four steam engines in Siam.

Summing up, the writer of the article in the *Sulzer Review* states:—It has been shown that it is now possible to construct Diesel locomotives of any required output, so that Diesel traction is technically on an equal footing with electric and steam traction. By this it is not intended to imply that Diesel traction is under all circumstances superior to other systems as regards economy; it will, however, take an important place in railway communications. Just as an elevated or underground railway, tramway, trolley or petrol omnibus, has each its particular place in the traffic of a town and in the suburbs, so may steam, electric or Diesel traction be adopted for main railways, according to the density of traffic and the extent to which the time-table allows the vehicles to be utilized, unless local conditions, such as lack of water or fuel, make one or other of the systems preferable. Express train traffic over greater distances with powerful locomotives is a type of service for which the Diesel locomotive could be adopted with particular advantage, since fuel consumption is responsible for a greater percentage of the total working costs in such service more than in any other.

It is to be expected that the cost of producing oil from coal by means of low-temperature carbonization will gradually be reduced. Consequently, countries producing coal will, in a reasonable time, be in a position to produce Diesel engine fuel oil at competitive prices, so that also in these countries, where there is an abundant supply of cheap coal, Diesel traction will unquestionably be advantageous.

The six or eight-cylinder four-cycle Sulzer Diesel engine specially developed for traction consists of one block of six cylinders or two blocks of four cylinders each, bolted together. The principal frame of the engine is of cast steel, the connecting rods are of chromium-nickel-steel, and the pistons of aluminium. Owing to the adoption of these special materials the total weight, and especially the weight of the moving masses, has been kept low.

**Eastern Engineering and Commerce.*



750 b.h.p. Shunting Locomotive of The South Manchuria Railway Company at Dairen taking in fuel

one or more cylinders should misfire or be cut out during service, which may happen owing to failure in delivery of fuel, the governor will cause the load to be distributed over the other cylinders, which are consequently overloaded. This is soon observed, as an additional instrument is fitted in the cab to show the lift of the governor, and at once indicates any irregularities in the working of the engine. The same apparatus also contains an indicating device to show if the cooling-water and lubricating oil are circulating normally.

In each cab there is also an instrument to show the speed of the locomotive; one of them is of the recording type.

South Manchuria Railway

At the end of 1930 Sulzer Brothers, Winterthur, delivered a 750 b.h.p. Diesel-electric locomotive to the South Manchuria Railway Co. The locomotive is used for shunting service in the port of Dairen and also for hauling mixed passenger and goods trains on the company's main lines.

The locomotive was designed and all drawings prepared by Sulzer Brothers, Winterthur, who also built the Diesel engine. The supply of the electric part was confided by Sulzer Brothers to the Ateliers de Construction, Oerlikon, and that of the mechanical part to the Société Industrielle Suisse, Neuhausen.

The following are the principal data :—

Gauge	1,435 mm. (4-ft. 8½-in.)
Length	12,300 mm. (40-ft. 4-in.)
Distance between bogie pivots	6,700 mm. (22-ft. 0-in.)
Wheel base of bogies	2,500 mm. (8-ft. 2-in.)
Number of axles	4
Number of driving axles	4
Diameter of driving wheels	1,120 mm. (3-ft. 8-in.)
Service weight of locomotive	80 tons
Adhesion weight	80 tons
Sulzer Diesel engine	8 cylinders
Output (continuous) of the Diesel engine at	
620 revs. per min.	750 b.h.p.
530 revs. per min.	640 b.h.p.
440 revs. per min.	530 b.h.p.
Maximum tractive effort at starting	16,200 kg. (35,650 lb.)
Tractive effort at 20 km. (12½ miles) p.h.	7,500 kg. (16,500 lb.)
Maximum speed of the locomotive with trailers	40 km. (25 miles) p.h.
Maximum speed of the locomotive alone	60 km. (37½ miles) p.h.
Minimum radius of curves	70 m. (3½ chains)

The locomotive is capable of drawing a load of 1,800 tons at a speed of 15 miles per hour on the level. Because of the load of 20 tons on each axle and to give the advantage of high adhesive weight for the shunting service for which it is intended, the locomotive is of fairly heavy build in proportion to its power.

The design of the Diesel engine and the system of electric transmission are already described.

The water for cooling the working cylinders and the cylinder covers is cooled in a closed circuit, being circulated through two coolers arranged at both ends of the locomotive. In order to increase the cooling effect, a fan is fitted behind each cooler to draw air through the end of the cooler and expel it again through an opening in the roof. These fans are driven by electric motors and can be run at various speeds in order that the cooling effect may be adjusted to suit the outside temperature. Special coolers are also fitted on the side walls of the locomotive for cooling the lubricating oil.

The auxiliary dynamo gives an approximately constant voltage of 150-volts at all three speeds of the Diesel engine. It is automatically connected to or disconnected from the battery of accumulators by means of a charging and a non-return relay working in conjunction with an electro-magnetically operated charging contactor. The battery consists of 96 iron-nickel cells, connected in series, with a capacity of 400 ampere-hours.

The motor compressor group for providing air for the brakes is designed for supplying 106 cub. ft. per min. at a pressure of 100 lb. per sq. in. It is automatically switched in when the pressure in the air receiver has fallen to 70 lb. and automatically switched out when it has again risen to 100 lb. per sq. in.

Each driver's cab is heated by a radiator and a footwarming plate, the necessary current being taken from the accumulators. The accumulators also provide current for lighting; a small resistance is provided, by means of which the voltage of the current to the lamps is automatically reduced during charging, so that lamps for 100-volts can be used as stipulated by the railway company.

The driver's cabs contain the normal equipment already described.

The locomotive is fitted with automatic and non-automatic Westinghouse brakes and with a hand brake. The driver's brake valves and the triple valve are combined for the automatic and non-automatic brakes. Two brake cylinders transmit the braking force through a rod to the brake blocks on the bogie; there are two brake blocks on each wheel. The hand brake can be operated from either cab and acts on both bogies.

After running some trials in Switzerland, the locomotive had certain parts removed in order to bring it within the Italian loading gauge and was then taken to Genoa, running on its own wheels. For the transport by sea from Genoa to Dairen, it was only necessary to detach the bogies from the frame.

The locomotive has been in regular service since 1931.

Royal State Railways of Siam

The Royal State Railways of Siam ordered from Sulzer Brothers six Diesel-electric locomotives, each of 450 b.h.p., and the trials of the first locomotive were run from July 6 to 20, 1931, in Switzerland, on the Landquart-Chur-Disentis line of the Rhaetic Railways.

In all, the locomotive made eleven return trips and ran a total of 763 miles, not counting the distance covered when shunting. The trials passed off without the slightest hitch, and the results were highly satisfactory to the purchasers and the builders of the locomotive. The total service done amounted to 94,350 ton-miles, in which figure the weight of the locomotive itself is included. During the trials, from the time the engine was first set to work until the tests were finished, a total of 3,410 lb. of fuel was consumed, including the amount used when shunting. The specific fuel consumption was therefore about 0.035 lb. per ton-mile; considering the steep gradient of the line and the numerous curves, this must be considered as very favorable. The cooling-water temperature never rose above 154 deg. Fah., although the cooler fans ran at a reduced speed during the whole trials.

The manœuvring and shunting operations were carried out with ease and smoothness, and acceleration tests were also made, the train being stopped several times on a gradient of 1 in 37 and again started. The time required for acceleration from stop to 19 miles per hour was then 30 to 35 seconds. It should also be noted that the line on which these trials were carried out has several successive curves of six chains radius, which considerably increased the resistance.

The locomotives are intended for working through traffic on the Siamese main lines, which are 1-meter gauge. They have been built to Sulzer Brothers' design, the electrical equipment being supplied by the Ateliers de Construction Oerlikon, and the mechanical parts by Henschel und Sohn A.-G., Cassel, Germany.

The principal particulars are as follows :—

Gauge	1 m. (3-ft. 3⅜-in.)
Length over buffers	13.59 m. (44-ft. 6¾-in.)
Distance between bogie pivots	7.4 m. (24-ft. 3-in.)
Wheelbase of bogies	3 m. (9-ft. 10-in.)
Number of traction motors	4
Number of driving axles	4
Number of carrying axles	2
Service weight (about)	60 tons
Minimum adhesion weight (about)	43 tons
Diameter of driving wheels	914 mm. (36-in.)
Diameter of free wheels	762 mm. (30-in.)
Sulzer Diesel engine, fourstroke cycle	8 cylinders
Output (continuous) of the Diesel engine at	
700 revs. per min.	450 b.h.p.
620 revs. per min.	400 b.h.p.
530 revs. per min.	340 b.h.p.
Maximum speed	60 km. (37½ miles) p.h.
Tractive effort—one hour rating—at 20.5 km. (12.8 miles) p.h.	4,150 kg. (9,130 lb.)
Maximum starting tractive effort	9,400 kg. (20,680 lb.)

The cooling-water for the Diesel engine is circulated through coolers fitted on both sides of the locomotive. Two fans driven by electric motors draw the air, which enters the side walls, through the coolers and then expel it through openings in the roof. By means of field tappings the speed of the fans, and consequently the cooling effect, can be varied.

The coolers for the lubricating oil are integral with the water coolers.

The generator is self-ventilated, a fan mounted on its shaft drawing air through the active parts.

The locomotive is provided with a vacuum brake and a hand brake. Compressed-air sanders for all driving wheels and for both directions of running, are fitted on the bogies.

The body of the locomotive consists of a steel framework covered with sheet metal, and the roof over the engine compartment is removable, in order to facilitate overhaul of the Diesel-electric set.

Tanks for fuel and water, and the silencer, are arranged in the roof, where the regulating resistances are also situated, the latter being protected by a removable sheet-metal cover. Partitions between engine and cabs are of strengthened sheet metal, as are also the doors. The floor of the engine compartment on both sides of the Diesel engine is double; the lower floor is of sheet iron and the upper one, the actual floor, is of teak. The space between them is used for the cables and piping. The frame of the locomotive is formed of rolled sectional members. The draw bar and buffer gear is fitted on the bogies, which support the main frame on spherical pivot and substantial side bearings.

Diesel-Electric Rail Cars

The adoption of rail cars in railway service is a question of general interest at the present moment. The effect of the competition from motor-cars, to which must be added the general depression caused by the present crisis, induces railway companies to improve their means of communication in less frequented districts, whilst at the same time avoiding any increase in expenses.

The two reasons which have just been mentioned might possibly lead one to think that it is only comparatively recently that the necessity for rail cars has been felt. But when the conditions are considered in which a small railway company that is not favored by dense traffic is placed, it will be easily understood that such a company was already obliged before the years of the crisis to obtain as much benefit as possible from local transport. Increasing the number of trains and especially of local trains, replacing mixed trains by separate trains for passengers and goods traffic, improving communications with neighboring railway systems, introducing late trains in the evening—all these means could be adopted to increase passenger traffic. A corresponding increase in expenditure could certainly not be avoided if the method of traction was not at the same time altered. Adopting the Diesel-electric rail car, which had already been developed before 1914, would be the appropriate solution.

1.—The low consumption of fuel which can be purchased at a moderate price, and the fact that no fuel is consumed during stops, driving the car by one man—these are advantages which allow economies to be realized exceeding the extra expenses caused by increasing the number of trains.

2.—The rail car is constructed as a normal railway carriage and is fitted with an engine powerful enough to allow of trains being built up from existing rolling stock; in case a large number of passengers have to be conveyed, the composition of the train can be adapted to cope with this without any increase in staff. Even when steam traction is retained along with Diesel traction, for example for goods service, the rolling stock is all standard. This is not the case for motor coaches adapted to run on rails, which are special machines and cannot be coupled to existing rolling stock.

The advantage of adopting the rail car is, however, not limited to small companies, since most of the large railway systems also have certain lines of purely local interest, or can utilize rail cars on purely non-electrified main lines in order to improve the means of communication between intermediate stations and those served by express trains.

Rail Cars of the South Manchuria Railway

The South Manchuria Railway Co., Dairen, put two 50 b.h.p. Diesel rail cars in service at the beginning of 1932; these vehicles were ordered later than the 750 b.h.p. Diesel shunting locomotive, which is also described here. The principal frame and the body of these cars were built in the railway company's own workshops, whilst the Diesel-electric equipment and the bogies were supplied by Sulzer Brothers.

The principal characteristics of the rail cars are as follows (see also wiring diagram, fig. 18):—

Gauge	1,435 mm. (4-ft. 8½-in.)
Length between buffers	17,756 mm. (58-ft. 3-in.)
Distance between bogie pivots	11,100 mm. (36-ft. 6-in.)
Wheel base of bogies	2,500 mm. (8-ft. 2-in.)
Number of axles	4
Number of driving axles	2
Diameter of the wheels	1,040 mm. (3-ft. 5-in.)
Weight of rail car in running order	48.3 tons
Diesel engine output, continuous rating	
at 775 revs. per min.	250 h.p.
at 650 revs. per min.	210 h.p.
at 525 revs. per min.	170 h.p.
Maximum speed of rail car	65 km. (40 miles) p.h.
Maximum tractive effort at the rail	4,000 kg. (8,800 lb.)
Tractive effort at 25 km. (15 miles) per hour,	2,000 kg. (4,400 lb.)
one hour rating	1,300 kg. (2,860 lb.)
Tractive effort, continuous, at 30 km. (19 miles) per hour	
Radius of sharpest curve	70 m. (3½ chains)

The four-cycle Diesel engine has six cylinders and is of the usual type employed in traction. The water coolers are fitted on the roof of the car; they are composed of gilled tubes placed transversely. As soon as the circulating pump is stopped, the coolers empty automatically, thus preventing any risk of freezing.

The lubricating oil is cooled in the crank-case below the engine, the lower part being exposed to the current of air produced when the car is running.

The electric equipment and accessories are similar to those in the cars previously supplied.

The rail car has seating accommodation for 65 third class passengers in one compartment. There is also a compartment for the machinery, and two cabs for the driver. The body of the car is built on a frame of rolled-iron sections, and covered internally and externally with wood. The battery of accumulators is located in boxes placed under the principal frame between the bogies. Except for the traction motors, all parts of the electric equipment and apparatus are placed in the machinery compartment or the driver's cabs. The roof above the engine-room may be removed along with the coolers contained in it, in order to allow the Diesel generator set to be hoisted complete out of the car. The suspension of the bogies is very carefully designed. The axle bogies, provided with ordinary bearings with oil pads, are fixed to the frame of the bogie through helical springs.

The two rail cars described here are in regular service in Dairen and district.

Pig-iron Combine in Japan

According to a report from Yokohama, the Commercial and Industrial Minister of Japan recently asked the Director of the Imperial Works at Yawata to get and submit to him figures of the output of pig-iron and its cost of production at each of the various blast-furnace plants in Japan. Proposals have been made to amalgamate the six pig-iron producers, but a difference in their interests is thought to make that very hard of realization. According to an official investigation, the cost of production in Japan is Y.53 (£3 10s. 8d.) for steel ingots, and Y.40 (£2 13s. 4d.) for pig-iron per ton. The Minister is afraid that by buying up the iron and steel works such an enormous amount of capital would be locked up as to make the business unprofitable, and cause too for a rise in the prices in consequence, that would only aggravate the situation. He seems to be, however, inclined to have the leading pig-iron works bought up by the Yawata works, if possible, but at the moment to be doubtful about finding the necessary funds.—*Foundry Trade Journal.*

THE FAR EASTERN REVIEW

上海黃浦灘念四號

遠東時報

JAPAN AND THE OPEN DOOR IN MANCHOUKUO

THE OPEN DOOR AS INTERVENTION

THE OPEN DOOR AN ECONOMIC ILLUSION

ENGINEERING IN CHINA

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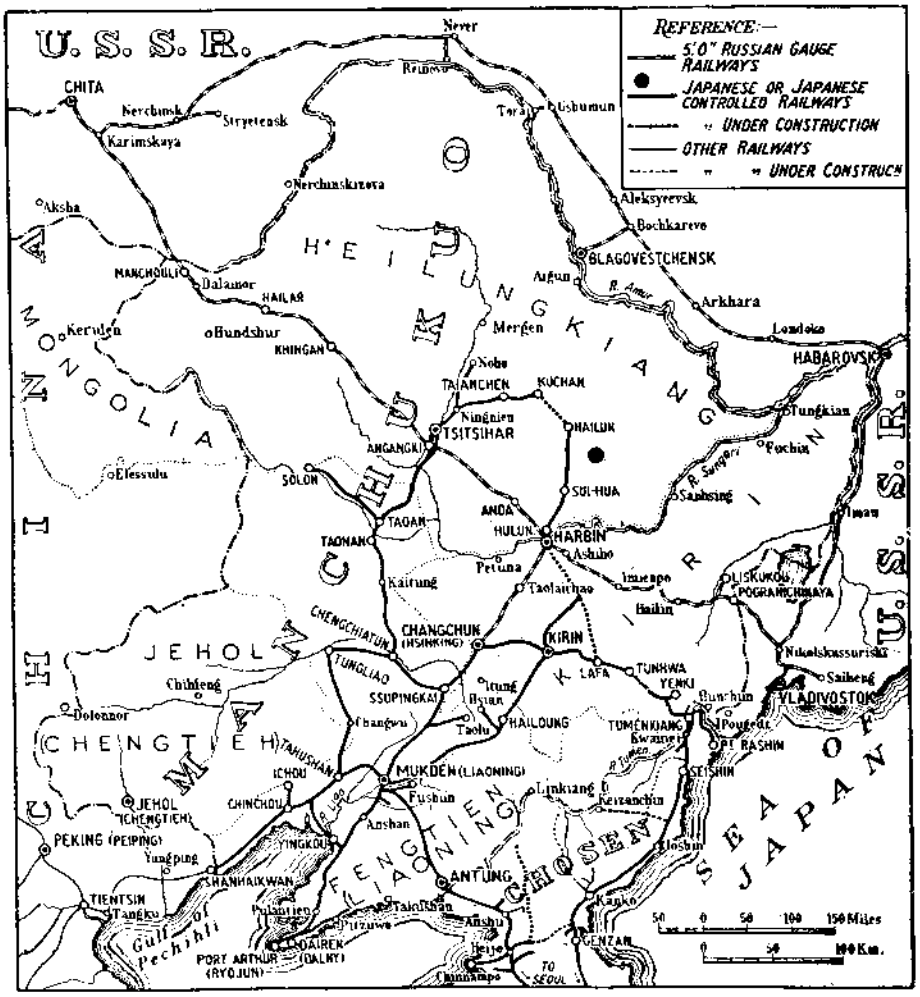
The Manchurian Railway System*

In consequence of the South Manchurian Railway having, by arrangement with the Manchoukuo Government, taken over the management of all the railways in Manchuria, with the exception of the Chinese Eastern Railway, an extraordinary general meeting of the company was recently held in Tokyo, for the purpose of altering the articles of association, and obtaining sanction for the issue of new capital.

Of the 3,600,000 new shares of Y.100 each, 2,200,000 have been allocated to the present shareholders, 200,000 to the company's servants, and the remaining 1,200,000 offered for public subscription, the total capital, including the new issue, totalling Y.800,000,000. On the formation of the South Manchuria Railway in 1906 the capital was Y.200,000,000, and by 1920 it had risen to Y.440,000,000, half of which was held by the Japanese Government.

The taking over of the various lines in Manchuria by the S.M.R. has been found convenient, both by the State and by the company, in settling the enormous liabilities and loans, totalling Y.130,000,000, which Manchoukuo is under an obligation to repay, or has incurred in favor of the S.M.R. in connection with the following ex-Chinese National Railways :—Kirin-Changchun, Kirin-Tunhwa, Kirin-Hailoung, Ssupingkai-Taonan, Taonan-Angangki, Taonan-Solon, Tsitsihar-Kochan, Hulun-Hailun, Mukden-Hailoung, and Mukden-Shanhaikwan. The properties and revenues of these lines are to form the security for the loans and liabilities, and the management has been entrusted to the S.M.R., who, to cope with the increased mileage of their system, have created two new Boards : the Construction Board, and the Railway Board. The former has three general offices, and four construction offices located at Kirin, Harbin, Tsitsihar and Rashin, while the Railway Board is divided into six departments, including a patrolling office, which looks after the policing of the Railway Zone.



Sketch Map of the Railways (and their gauges) of Manchoukuo

All claims and debts existing between the Manchoukuo Government and any third party concerning any of the above-mentioned railways, will be settled by the S.M.R. in consultation with the Government, the company having agreed to pay out of the revenues derived from the management of these railways. The Mukden-Shanhaikwan Railway, which previously formed part of the Pekin-Mukden Railway, is under an obligation to repay various loans to the British and Chinese Corporation, and is to be excluded from the security of the present contract until the question of settling the loans has been discussed.

The Manchoukuo Government has also concluded a separate contract with the S.M.R. for the construction of new lines from Tunhwa to the River Tumen, from Harbin to Lafa, and from Taianchen to Hailun, the total cost of construction amounting to approximately Y.100,000,000 ; the Taianchen-Kochan section is now completed. In connection with the Tunhwa-River Tumen Railway, it has been necessary for the State to purchase the existing Tunhwa-Tumen Light Railway, and for this purpose has borrowed Y.6,000,000 from the S.M.R. The construction of the Tunhwa-Tumen line has been completed and regular operation was commenced in August after the signalling and stations were finished.

In addition to new lines, the present program includes the construction of 2,000 steel freight cars at the Shakako (Dairen) shops, and the reconstruction of the Ranan Harbor at Rashin, and the construction of a new 200 meter bridge on the Taonan-Tsitsihar section, the contract for the last named having recently been awarded to a German firm at a price of Y.2,200,000. The unification of passenger rates throughout the country is also being given a great deal of attention, as the old Chinese National lines each had a scale of their own.

*The Railway Gazette.

Manchoukuo Oil Schemes

Manchoukuo is reported to be making plans for the erection of an oil refinery at Hulutao, the new port which Manchoukuo hopes to develop. This plant will have a daily capacity of 4,000 barrels of gasoline, and may commence operations with imported crude oil, probably from Russia. In the neighborhood of Hailar there are crude oil seepages and geologists are there to prospect and prepare for drilling this summer. If oil is brought in paying quantities, another refinery may be built at Hailar. There are said to be two most important and promising oil fields in Manchoukuo. One is near Chiufutan in Jehol Province. About 30 years ago the Standard Oil Company made boring tests there. The other field is at Dalainor, not far from Manchuli. Both Soviet and Chinese experts have looked over this field, and just before the Mukden incident of September 18, 1931, the South Manchuria Railway Company planned to sink some test wells there. Now it is understood that drilling will start at once.

The Nankow Pass on the Peiping-Suiyuan Railway*

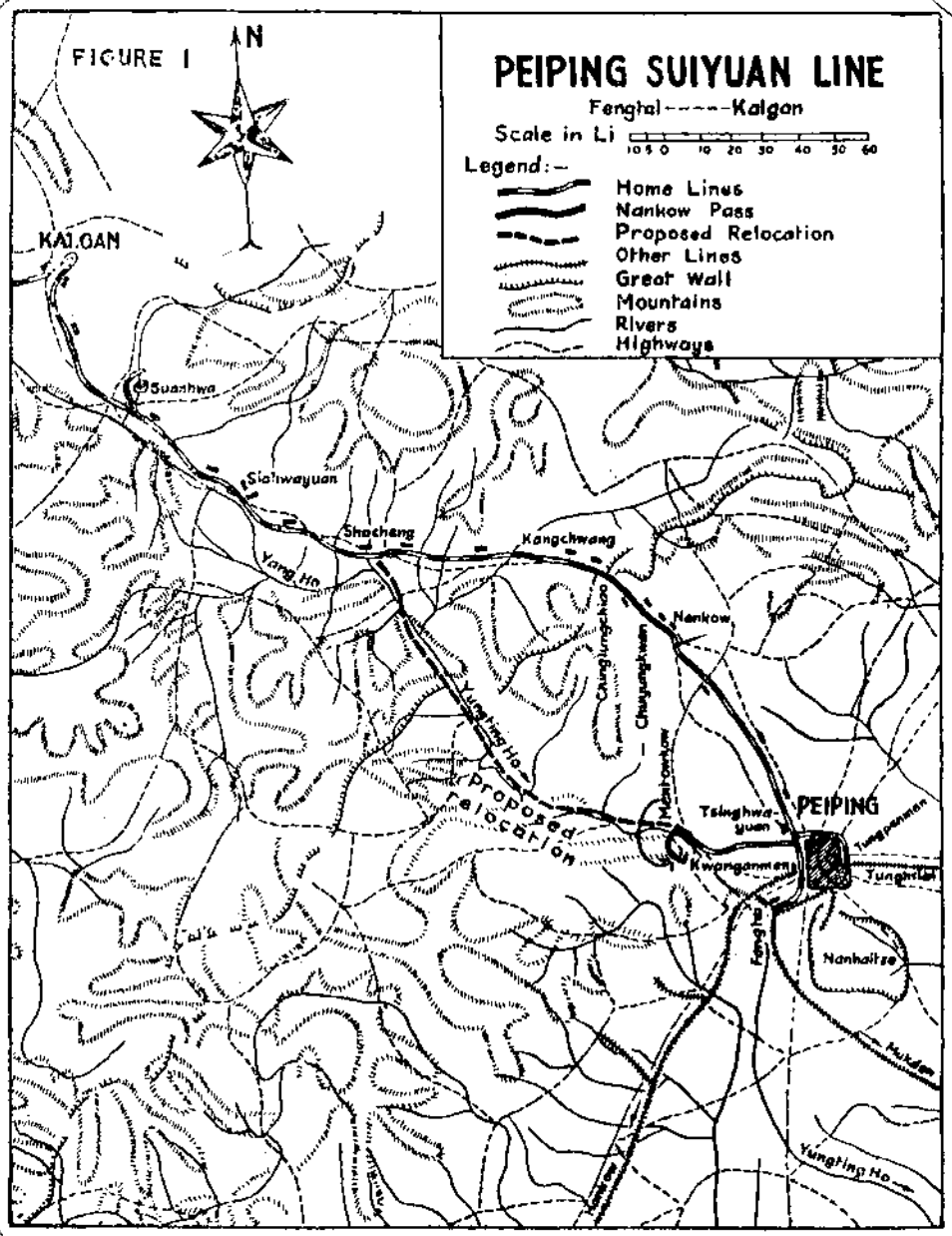
By T. KING, Chief Engineer, Peiping-Suiyuan Railway

In May, 1905, the Imperial Chinese Government decided to build a standard gauge railway between Peking (now Peiping) and Kalgan, employing only Chinese engineers and making use of part of the annual surplus from the Peking-Mukden Railway, then the Imperial Railways of North China. The late Dr. Jeme Tien Yu was appointed Chief Engineer of this new Railway. Work was begun in October 1905, and the whole line was open to traffic in September 1909. The main line then built started from Fengtai, a suburban town south-west of Peking and a junction station of three important railways, viz: the Peking-Mukden, the Peking-Hankow and the Peking-Suiyuan; and terminated at Kalgan, a trading center on the Mongolian border, covering a distance of 125 miles, now a part of the Peiping-Suiyuan Railway. According to the report submitted in 1909, the total cost amounted to Tls. 6,935,086. The foregoing cost included, among other items, the following:

(*a*) A branch line from Hsichihmen station (at Peking) to Mentowkow, 16.13 miles.
(*b*) A branch line from Sia Hwa Yuan station (35.7 miles from Kalgan) to Che Ming Shan Coal Mine, 1.53 miles.
(*c*) Che Ming Shan Coal Mine, operated by the Railway.
(*d*) 19 locomotives and 328 cars.
(*e*) A central mechanical works at Nankow.

While comparatively heavy and costly work can be found here and there throughout the whole line, such as the bridges over the Sha River (near Peiping), over the Yung Ting River (on the Mentowkow branch) and over the Hwai Lai River (near Hwai Lai station), and the sidehill work along the Yang River in the vicinity of Sia Hwa Yuan station, etc. etc., the most important and difficult part of the work was to push the line through the so-called "Nankow Pass," the successful completion of which has won for Dr. Jeme such a national and international reputation as has been enjoyed by but few of the Chinese Engineers. The following is a brief description of the Peiping-Suiyuan Railway through the Pass as is found to-day. For a general plan of the Peking-Kalgan Railway, see Fig. I.

FIGURE I



Alignment

The first 28.34 miles from Fengtai (Elevation† = 117.8-ft.) to Chang Pin Hsien (Elevation = 146.24-ft.) runs on a flat plain, while the next 5.8 miles from Chang Pin Hsien to Nankow (Elevation = 315.00-ft.) continues on a rising grade with a maximum grade of 1 in 100 or 1 per cent. The line from Nankow to Kangchwang, popularly known as the Nankow Pass, follows the main road up a natural valley, used by caravans and carts ever since the beginning of the Chinese civilization.

Table I shows the elevations and distances from Fengtai to all the stations in the Pass, as well as average grades between stations.

TABLE I.

Station Name	*Abbreviation*	*Elevation in feet*	*Distance in miles from Fengtai*	*Average grade*
Nankow ..	NKW	315.00	34.155	
Tungyuan ..	TYN	589.00	37.635	1 in 66.8 or + 1.5%
Chuyungkwan ..	CYK	1,052.68	40.450	1 in 32.1 or + 3.1%
Sanpu	SPU	1,466.55	42.848	1 in 30.6 or + 3.3%
Chinglungchiao .	CLO	1,841.00	45.340	1 in 35.1 or + 2.8%
Hsipeutze ..	HPT	1,800.98	48.982	1 in 4,800 or − 0.2%
Kangchwang ..	KCW	1,635.90	52.695	1 in 118 or − 0.85%

TABLE II.

From Station	*To Station*	*Distance in miles*	*Sharpest Curvature, Radius in feet*	*Maximum grade, uncompensated*
NKW	TYN	3.480	1000	1 in 40 or + 2.5%
TYN	CYK	2.815	700	1 in 30 or + 3.3%
CYK	SPU	2.398	700	1 in 30 or + 3.3%
SPU	CLO	2.492	600	1 in 30 or + 3.3%
CLO	HPT	3.642	600	1 in 32 or + 3.1% in one direction 1 in 62 or − 1.6% in other direction
HPT	KCW	3.713	5000	1 in 70 or − 1.4%

Table II shows the actual maximum grades and sharpest curvatures of the main line in the Pass.

In this 18.54-mile section, there are altogether 51 curves, with an aggregate curve length of 6.51 miles. Considering only the NKW-HPT section, there are 50 curves, with a total length of 6.03 miles in 14.83 miles of the main line, i.e. in every 1,000 feet of main line, there is a curve of 406 feet! Regarding the grades in this 18.54-mile section, there is only 5,920 feet, or 1.12 miles, which is on the level. If the level lengths in NKW, CLO and KCW stations are excluded, the no-grade interstation lengths have

*Journal of The Association of Chinese & American Engineers

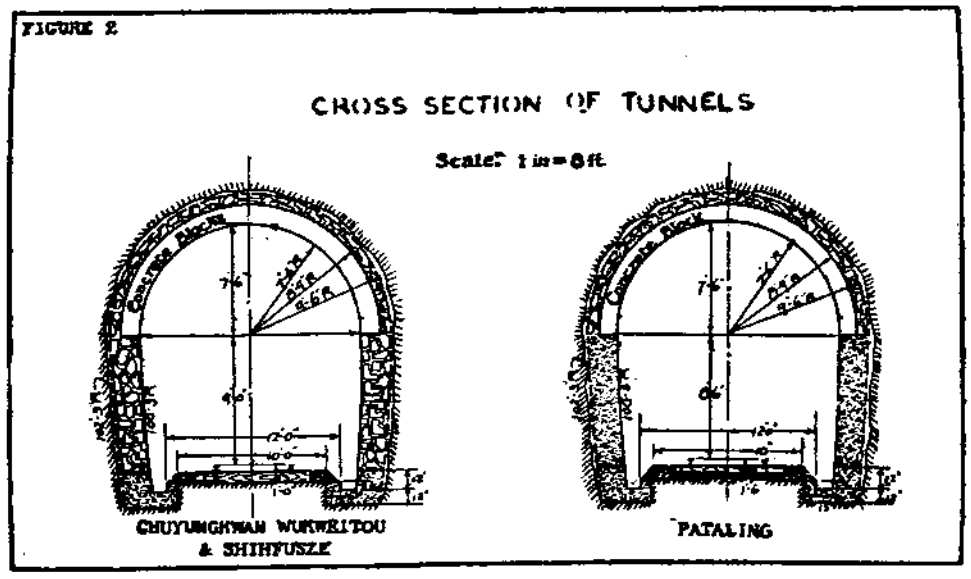
†Elevations mentioned herein are those referring to an arbitrary datum which is itself 121.78 feet above the mean sea-level at Tangku.

a total figure of only 1,050 feet, or 1/5 mile, in 18.54 miles of the main line! Here also, it might be noted that the other stations; viz., TYN, CYK, SPU and HPT, are on grades of 1 in 50, 30, 33, and 160, respectively.

The main line, after running up to CLO station, switches back therefrom on ascending grades, while entering the long Pataling tunnel. The line reaches the highest point in the Pass (elevation = 1,959.20-ft.) in the said tunnel, at a distance of one mile from the center of CLO station, and then descends from this summit to KCW.

Transition curves, 150 feet long at each end, are used on curves with radii of 800 feet or under.

FIGURE 2



Track

Rails 30 feet long, 85 pounds per yard, Sandberg section, hardened by the Sandberg sorbitic process, are laid on tieplates throughout the section, strengthened on curves with rail braces, and fastened with dog spikes. The joints are alternate.

Sleepers are of two sizes, 9-in. by 6-in. by 8-ft. and 9-in. by 7-in. by 9-ft. For each rail-length, four pieces of 9-in. by 7-in. by 9-ft. and 12 pieces of 9-in. by 6-in. by 8-ft. are used on the NKW—HPT section, one piece less of the 9-in. by 6-in. by 8-ft. sleeper on the HPT—KCW section. The 9-in. by 7-in. by 9-ft. size is the joint sleeper, two being used at each rail-joint. Treated sleepers were laid in the Pataling tunnel and are still in fairly good condition. When the track was first laid, all the sleepers in the Pass were coated with coal tar, but this practice was discontinued in the renewals of recent years. An extra fishplate (angle bar) is bolted and spiked on the outside of each rail at its mid-length opposite the joint in the other rail. This extra fishplate and the longer sleepers are used with the idea of preventing rail-creeping.

Broken stone is used as track-ballast, the thickness under the sleepers being from 6-in. to 8-in.

Bridges and Culverts

There are no bridges of any considerable size in the Nankow Pass. Those worthwhile to be mentioned are as follows:

(*a*) One open-deck bridge of single span, 100-ft. deck warren-truss, between NKW and TYN.
(*b*) One 40-ft. arch culvert, between TYN and CYK.
(*c*) Three 30-ft. arch culverts, between CYK and SPU.
(*d*) One 40-ft. arch culvert, between CYK and SPU.
(*e*) Five open-deck spans of 30-ft. rolled I-beams, between HPT and KCW.

All the bridges and culverts in the Pass are meant to carry a live load equivalent to Cooper's Class E50. All the arch culverts are of plain concrete.

Tunnels

There are four tunnels in the Nankow Pass, tabulated as below:

TABLE III.

Name of Tunnel	*Between Stations*	*Length in ft.*	*Lining*	*Portals*
Chuyungkwan	TYN & CYK	1,204	Concrete arch Rubble sidewalls	Concrete
Wukweitow	SPU & CLO	150	Concrete arch Rubble sidewalls	Concrete
Shihfusze	SPU & CLO	463	Concrete arch Rubble sidewalls	Ashlar granite back filled with concrete
Pataling	CLO & HPT	3,580	Concrete arch and sidewalls	ditto

The two short tunnels are almost entirely on curves. The Chuyungkwan tunnel has its southern end, 159-ft. long, on a spiral transition curve, while the whole of the Pataling tunnel is on a tangent.

The Chuyungkwan tunnel is on an up-grade of 1 in 30 throughout and both of the two shorter tunnels are situated on an up grade of 1 in 33⅓. The grades in the Pataling tunnel are analyzed as follows: Starting from the south portal, i.e. CLO side, the first 100-ft. arc on up grade of 1 in 33⅓; the next 450-ft., on up grade of 1 in 100; the following 1,100-ft., on up grade of 1 in 45.45; the remaining 1,930-ft., on down grade of 1 in 500.

There is a shaft 10-ft. in diameter directly over the center line in Pataling tunnel. This was driven during the time of construction, and is now kept open for ventilation purpose.

The cross-sections of the tunnels are shown in Fig. 2. Unfortunately, the small clearance constitutes a great handicap in the operation of trains, especially the very poor ventilation that is found in running steam locomotives through the two long tunnels.

Refuge recesses 7-ft. long by 6-ft. deep by 7-ft. high are provided in the two long tunnels, 4 in Chuyungkwan tunnel spaced at about 200-ft. apart, 11 in Pataling tunnel spaced at about 300-ft. apart.

Stations

The stations NKW and KCW are terminals for operation of all trains running through this section. At both stations, there are engine sheds, water tanks, coaling stages, turntables, classification yards, etc. (The Central Mechanical Works and general stores are also located at NKW). The station CLO, while being equipped for watering engines, serves mainly for reversing the directions of trains, since it is a "switch back" station. It is also a passenger station for tourists who wish to visit the Great Wall of historic interest, on top of the Pataling hills. The remaining four stations TYN, CYK, SPU and HPT serve only for crossing trains and for catching any runaway trains or cars. Fig. 3 shows the track diagrams for these stations.

Crossing of Trains at Small Stations

By glancing at these figures, one will see that track arrangements at stations TYN, CYK, SPU and HPT differ from those found in small crossing stations in other sections of the Peiping-Suiyuan Railway or on any other Chinese Government Line. Take TYN for illustration. An up train (from Kalgan to Peiping) running on down grade must first stop and wait in front of switch A, which is normally set for the catch siding. A down train (Peiping to Kalgan) running on up grade should first stop between the switches A and B, then back into the passing loop and wait there. The up train then gives a long whistle from the locomotive, the switch A is now set for the main line, and the up train then moves on passing the switches A and B; after this, the down train in the loop proceeds through B and A and continues on its journey.

It should be here noted that any up train, whether crossing a down train or not, must first stop in front of A and sound one long whistle from the locomotive before it is permitted to proceed on the main line. Should the driver of the up train for any reason wish to have his train brought into the catch siding, he must give two long whistles. If there is no whistle, it should be understood that the up train or any runaway car is to go into the catch siding, i.e. one long whistle is the only signal for requesting to proceed on the main line.

In the case of crossing trains, before the down train is brought properly to stop in the passing loop, the switch A must never be

set for the main line, even if the up train waiting in front of A gives one long whistle.

Catch Sidings

In addition to the catch sidings provided in the stations, there are 7 more catch sidings located outside station limits as shown in Table IV. Each of the 7 sidings is attended day and night by two men, one on each shift, who are carefully selected and especially trained for this purpose. They appear on the Engineering Department Payroll while those working inside station limits are paid by the Traffic Department. The one-long-whistle rule applies also to these intermediate sidings.

Catch siding No. 1 below NKW station had been in existence from the time when Dr. Jeme first built the line. This was taken out in 1926 when track materials were urgently needed elsewhere, and was never reinstalled.

TABLE IV.

Number	*To*		*To*		*Length*	*Max. Grade*	*Min. Grade*
1	CPH	29070'.00	NKW	1576'.10	Taken	out in 1926	
2	NKW	4954.00	TYN	13409.00	4040	—1in 1875	—1in 74.00
3	NKW	15227.40	TYN	3136.50	812	+1in 37.03	—1in 69.44
4	TYN	6027.00	CYK	8833.40	870	+1in 23.41	—1in 34.36
5	CYK	6704.60	SPU	5957.90	676	+1in 25.10	—1in 24.36
6	SPU	7525.10	CLO	5632.00	1446	+1in 31.25	—1in 34.90
7	CLO	1202.10	HPT	18029.00	566	+1in 21.21	—1in 19.20
8	CLO	11874.10	HPT	7357.00	716	+1in 20.82	—1in 76.12
TYN					2640	+1in 16.12	—1in 32.00
CYK					2069	+1in 18.00	—1in 31.25
SPU					858	+1in 10.02	—1in 34.41
HPT					1218	+1in 25.26	—1in 69.82

Note: — Stands for down grade.
+ Stands for up grade.

Signals

In the Nankow Pass, only the stations NKW, HPT and KCW are provided with the usual distant and home semaphore signals, interlocked with the main line switches, the rest of the stations having no fixed signals whatever. As the trains in the Pass are allowed to run at 10 miles an hour only, and as all the employees of Engineering, Locomotive and Traffic Departments, working in this section, are specially trained and particularly cautioned for any carelessness, it is generally considered that fixed signals at intermediate stations are not absolutely necessary, as may so appear to an outsider. Thanks to the faithful and vigilant efforts of the employees, very few serious accidents have happened in the Pass.

Electric Train Staff and Tablets

Trains running in the Pass are under the control of Electric Staff and Tablets, while the whole of the Peiping-Suiyuan Railway including the Suiyuan-Paotow Extension is still working under the Mechanical Link and Tablet System, with the exception of Hsichihmen—Kwanganmen section (at Peiping), which is also under the Electric Staff and Tablet working. It is partly due to this Electric control that very few train accidents have taken place in the Pass.

Rolling Stock

When Dr. Jeme first built the Railway, locomotives of the types Shay (6 in all, Nos. 25—30) and British Mallet (4 in all, Nos. 21—24) were used to handle trains in the Pass. The Shay engines are of the obsolete type, and run at very slow speeds. They are practically scrapped now. The British Mallets have a low tractive power which is now found rather inadequate in operation.

Seven bigger Mallet engines (Nos. 94—100) were purchased in 1914, and seven more still bigger Mallets (Nos. 201—207 were added in 1922. These two series of Mallets constitute at present the principal hauling power in operating trains in the Pass. One or two of the British Mallets are still in use, while none of the Shay engines is ever used now.

Fig. 4 shows the sketch diagrams of the said four types of locomotives with wheel spacings, and Table V gives some characteristic information concerning these engines.

Note that Mallet engines 94—100, and 201—207 are confined to run in the Nankow Pass only, and are not allowed to go beyond Nankow or Kangchwang, since the tracks and bridges outside this section are too weak for the loading.

Formerly, the passenger and freight cars of the Peiping-Suiyuan Railway were all equipped with air brakes. As a result of repeated civil wars during the last 10 years, most of the PSR cars have been taken away by military authorities to other lines. The few cars that are left behind have lost most of the parts necessary in the use of air brakes, and the Railway, being now in a very bad financial condition, is quite unable to replenish all of them. A few hundred cars belonging to other lines, now remain on PSR, available for its use, but nearly all of the foreign line freight cars are not equipped with air brakes. Consequently, while all the passenger cars have air brakes, nearly all of the freight cars have none.

The freight cars now circulating on PSR have capacities ranging from 40 long tons down to 10 long tons, and there are only about 500 freight cars of various sizes (and 60 passenger cars) on the whole of the PSR and its Paotow extension with a total main line mileage of 506, and a total branch line mileage of 37!

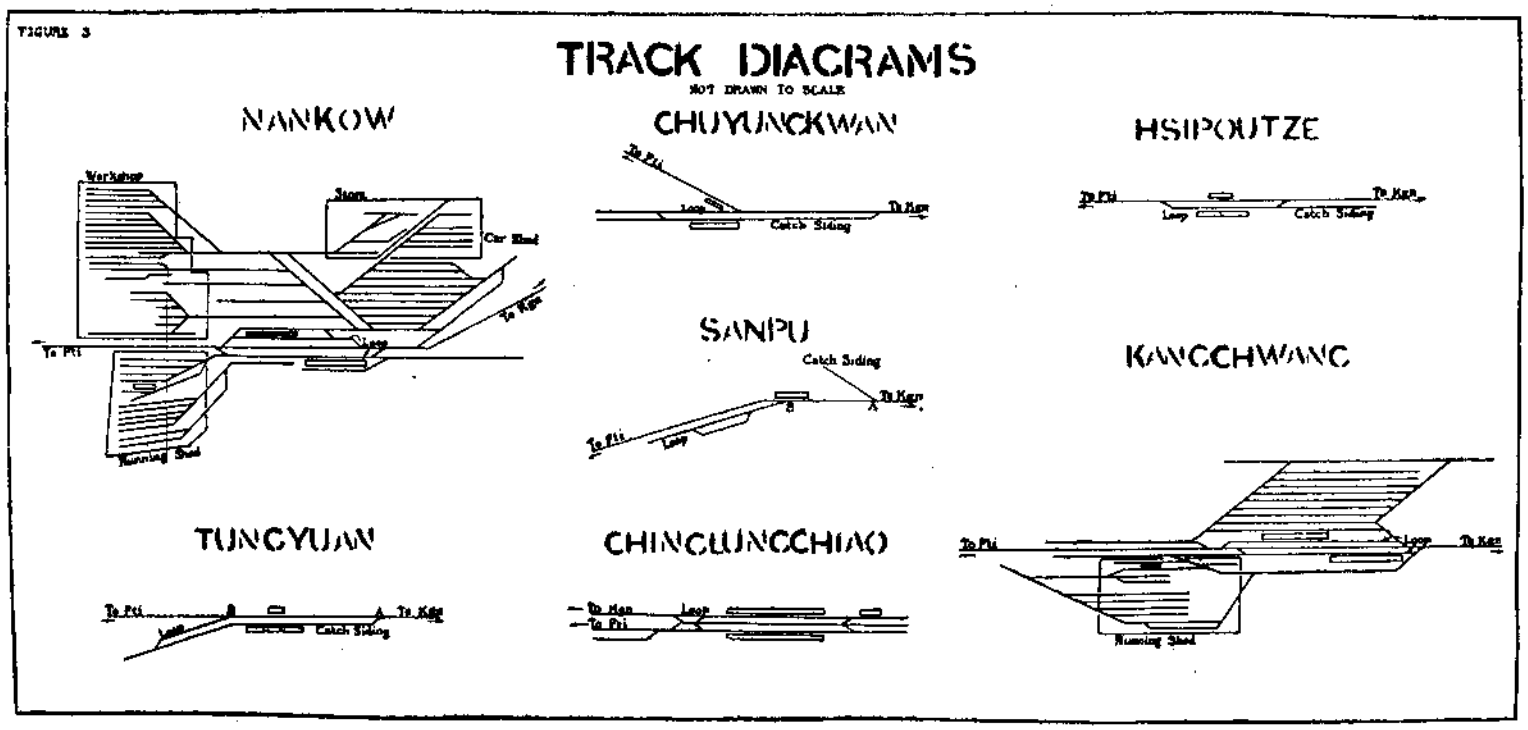


TABLE V.

Type of Locomotives	*Shay*	*British Mallet*	*Mallet*	*Mallet*
Wheel Arrangement	0-4-4-0	0-6-6-0	2-8-8-2	2-8-8-2
Road Nos.	25-30	21-24	94-100	201-207
Date of Adoption	1909	1908	1914	1922
Diameter of driving wheels, inches	40	51	50	50
,, ,, leading ,, ,,	—	—	30	30
,, ,, trailing ,, ,,	—	—	30	30
,, ,, tender ,, ,,	—	—	33	33
Cylinders, diameter inches	15	HP 18 LP 28	HP 20 LP 32	HP 24 LP 38
Cylinders, stroke inches	17	28	26	28
Boiler pressure, lbs. per sq. in.	200	200	200	220
Fire grate area, sq. ft.	38.8	45.1	59.6	95
Heating surface, total, sq. ft.	1904	2591	2626	5538
Heating surface, superheater, sq. ft.	—	—	565	1433
Weight in working order, long tons—				
Leading	—	—	10.9	12.72
Driving	78.69	96.5	106.5	173.43
Trailing	—	—	12	12.94
Engine	78.69	96.5	129.4	199.09
Tender	30.49	40.9	55.8	86.02
Tender Capacity—				
Water, U. S. gallons	3266	4000	6000	10000
Coal, tons	6.5	5.5	10	16
Maximum Tractive Power, lbs.	44115	46407	54357	92500

Train Operation and Difficulties

A down train from Peiping, on arrival at NKW, is generally decomposed into portions, and a Mallet locomotive is attached to the rear of each portion, pushing it up from behind as far as CLO where the direction of the train is reversed. From there on, the engine pulls the same portion up into the Pataling Tunnel and then down to KCW, where the several portions are recomposed, and an ordinary road engine is used to pull the train on to Kalgan or beyond.

An up train from Kalgan or beyond, on arrival at KCW, is likewise decomposed into portions, and a Mallet engine is attached to the front of each portion, pulling it to CLO. Here the direction of the train is reversed, and the engine is attached to the other end of the train, pulling it down to NKW, where the portions are recomposed, and an ordinary road engine is used to pull it on to Peiping or Fengtai.

Note that in pulling a down train from CLO station into the Pataling tunnel, running on steep up grades, there is a possibility of some car or cars being detached from behind, due to a broken coupling. Such runaway cars would run into the catch siding No. 7, located between CLO station and the tunnel, instead of running into the station. In pulling an up train from KCW to Pataling tunnel, on up grades, there is the same possibility, but the grades are comparatively more flat than on the other side of the tunnel, and moreover, the catch siding No. 8 and that in HPT station will catch any runaway car or cars.

TABLE VI.

Permissible Speed, 10 miles per hour		*Loco. Nos. 21-24*	*Loco. Nos. 94-100*	*Loco. Nos. 201-207*
NKW to KCW	Train with air- and hand-brakes complete	100 long tons	200 long tons	260 long tons
	Train without air- brakes but with hand-brakes complete	100 long tons	180 long tons	230 long tons
	Train without air- and hand-brakes	80 long tons	140 long tons	200 long tons
KCW to NKW	Train with air- and hand-brakes complete	100 long tons	300 long tons	400 long tons
	Train without air-brakes but with hand-brakes complete	100 long tons	225 long tons	350 long tons
	Train without air- and hand-brakes	80 long tons	100 long tons	120 long tons

Table VI shows the tonnages that can be safely hauled by the three classes of Mallet engines running in the Pass. Note that there is considerable decrease in tonnages when the cars making up the train have no brakes of any kind.

The tonnages are diminished by 10 per cent. in winter months from November 21 to March 20.

Owing to the fact that most, if not all, of the freight cars now on PSR have no air-brakes, and a large number of foreign line cars have lost some parts of their hand-brakes, the hauling capacities of the locomotives are very much reduced. An engine of the 94—100 series very often hauls down the pass a train consisting of only one loaded 40-ton car and a guard van, and another of the 201—207 series pulls a loaded train composed of only two 40-ton cars and a guard van!

It can then be seen that a loaded train of 600 or 700 tons from Kalgan, has to be divided into five or six portions, and hauled down to NKW successively as five or six separate trains. This not only increases unduly the operating expenses, but the cars are also used in a very uneconomical way, as they are usually held up at the stations NKW and KCW, waiting for despatch and choking up the yard tracks there.

FIGURE 4

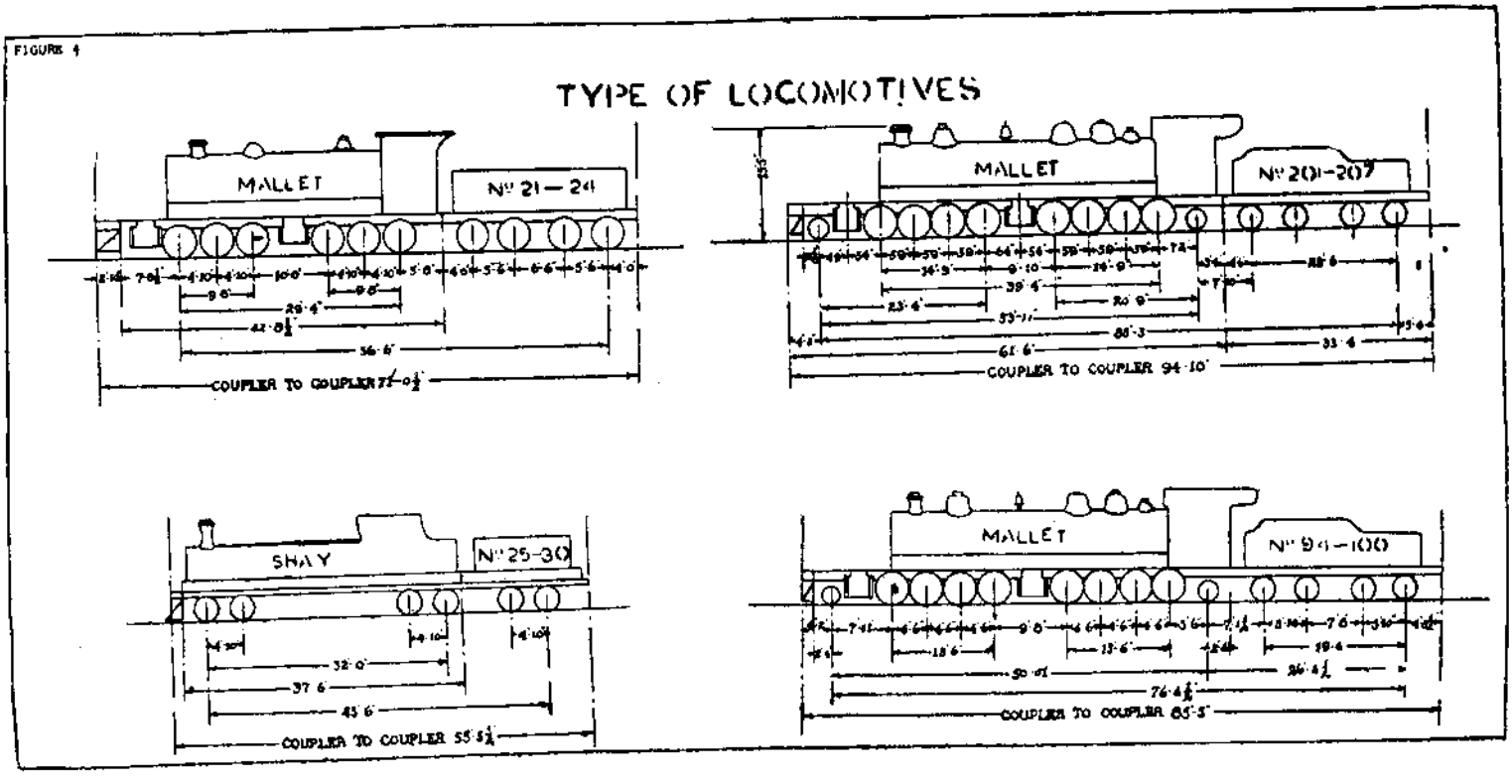


FIGURE 5

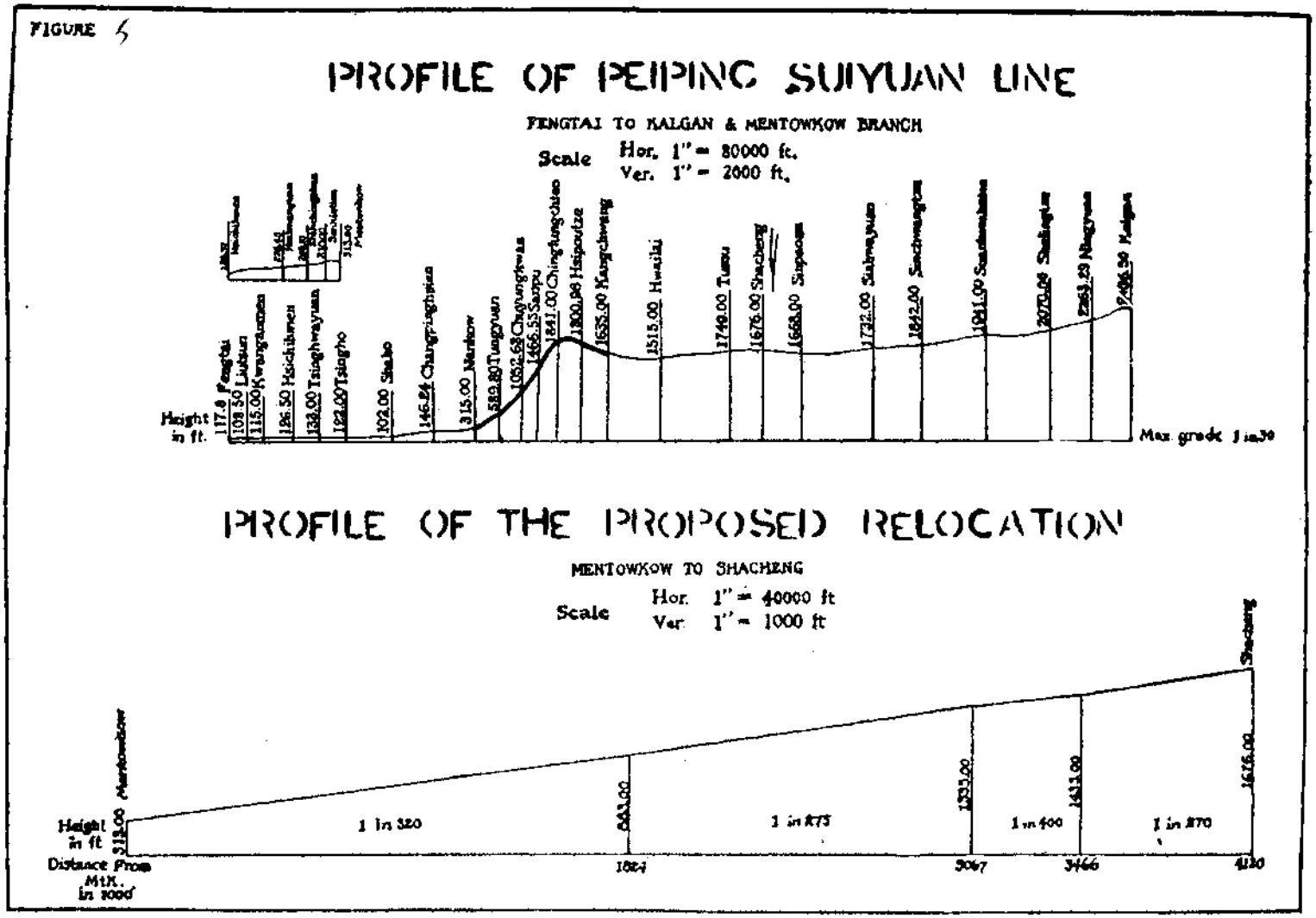

PROFILE OF PEIPING SUIYUAN LINE
FENGTAI TO KALGAN & MENTOWKOW BRANCH
Scale Hor. 1" = 80000 ft.
Ver. 1" = 2000 ft.
Height in ft.
Max. grade 1 in 30
PROFILE OF THE PROPOSED RELOCATION
MENTOWKOW TO SHACHENG
Scale Hor. 1" = 40000 ft
Ver. 1" = 1000 ft
Height in ft
Distance From Mtk. in 1000'
1 in 320
1 in 873
1 in 400
1 in 870

TABLE VIII.

Section	Locos.	Cars with or without Hand brakes	No. of Round trips Train Crew makes per day	No. of 40 ton loaded cars attached to a train	Cost of Train Operation per ton-mile	Comparative Ratio
Tatung to Kangchwang	Mikado Series	—		13	$ 0.000895	1.0
Kangchwang to Nangkow	Nos. 94 -100	Without hand-brakes	One trip	1	0.0343	38.3
			per day	2	0.0172	19.2
			Two trips	1	0.0255	28.5
			per day	2	0.0128	14.2
		With hand-brakes	One trip	2	0.0172	19.2
			per day	3	0.0114	12.7
			Two trips	2	0.0128	14.2
			per day	3	0.0085	9.5
	Nos. 201-207	Without hand-brakes	One trip	1	0.0386	43.2
			per day	2	0.0193	21.6
			Two trips	1	0.0299	33.4
			per day	2	0.0050	16.7
		With hand-brakes	One trip	5	0.0077	8.6
			per day	6	0.0064	7.1
			Two trips	5	0.0060	6.7
			per day	6	0.0050	5.6

At present, there are only about 8 to 12 trains both ways running daily on PSR other than the Nankow Pass, yet the number of trains running in the Pass, both ways, is already 44 to 56 per day, which is almost up to the full capacity of a single track railway. If, in the future, Railways are extended into the Provinces, Kansu and Sinkiang (Chinese Turkestan), and possibly into Outer Mongolia, too, resulting in the development of resources in the Northwest, the PSR would serve as a main artery for the traffic to and from the sea coast. The present capacity of the Railway through the Nankow Pass would then be far from equal to such a traffic demand.

Cost of Operation

For the sake of simplicity, we will consider only the actual operating expenses necessary in running the trains, disregarding the interest on capital cost, overhead expenses, depreciation and maintenance charges on fixed structures and rolling stock, expenses at stations, etc. Based upon data available at hand, Table VII has been prepared, showing the approximate costs of transporting one ton of coal per mile between Tatung (185.39 miles west of Kangchwang) and Kangchwang which is comparatively flat, and between Kangchwang and Nankow which is quite hilly as heretofore described.

Proposed Measures for Improvement

Not a few men now think it a great mistake on the part of the engineer who built the Peking-Kalgan Railway to have adopted the route through the Nankow Pass. In order to be fair to Dr. Jeme, we should bear in mind the fact that he was allowed at the outset a construction fund of only four or five million taels to build the whole of the Peking-Kalgan line in a specified time of three or four years. We are told that he did take other alternative routes into consideration, but as such routes would have required longer time and more money to be completed, he decided to adopt the

(Continued on page 479)

As to the repair of the damaged rubber covering, the affected part should be at once bound with strong cloth tape in order to prevent further extension of such damage, and should be carefully examined when the vessel is docked. If a part of the metallic surface of the shaft is exposed, the rubber at that part should be removed and the steel surface polished with carborundum cloth, and after wiping the surface with cloth soaked with benzine, specially prepared gum solution is painted. Then, rubber sheets cut in size of the damaged part are firmly stuck on the surface using hand rollers and the patches are piled up to a height somewhat higher than the original rubber covering surface. Parafined cloth or paper is placed upon this togother with a set metal. The part is then heated by steam or with an electric heater, upon which a wooden plank and a heavy weight are placed in order to give pressure upon the patch. The material is first heated up to about 150-160 deg. Cent. for about 2-2½ hours in order to unite the repairing material with the original covering. Such repairing materials are conveniently stored on board ship.

In conclusion, the vulcanized rubber covering with its homogeneous tight-fitting may be considered most suitable for the protection of the shaft from corrosion in comparison with other processs hitherto introduced, and it is lighter and cheaper than brasse sleeves.

The actual cost for the rubber covering of the propeller shafts of the s.s. *Soya Maru* and the estimated cost for the brass sleeves for the same shafts are Y.13,168 and Y.16,650 respectively, the corresponding weights per shaft being 14,699 kgs. and 15,759 kgs. respectively. Thus a saving of about 21 per cent in cost and about 6.8 per cent in weight were attained in comparison with brass sleeves.

The writer is greatly indebted to Mr. T. Morisawa, the late Manager of the Marine Department of the Imperial Japanese Government Railways in utilizing the full informations about the shaft covering of the s.s. *Soya Maru*, and also to Mr. F. Tsutiya, the Chief Engineer in the Yokohama Dock Co., Ltd. where the complete operation was carried out.

The Nankow Pass on the Peiping-Suiyuan Railway

(Continued from page 465)

present location, and, according to the records now available, he spent only about two million dollars (Mexican) in completing the Nankow Pass section. With the line gradually extended toward the West, and with the rolling stock depleted of brakes, the necessity of improving the existing conditions becomes more and more apparent.

Many schemes have been proposed to improve the situation. One proposal (A) was to add an intermediate crossing station between every two adjacent stations, to build a through loop, for crossing long empty trains, at each of the stations, TYN, CYK, SPU, CLO and HPT, and to lengthen all the catch sidings in the Pass. A second proposal (B) was to electrify the Nankow Pass section, making use of the water power of the Yungting River, or of the Che Ming Shan coal for the generation of electric power. A third scheme (C) was to abandon the existing main line between Hsichihmen (at Peiping) and Shacheng (a station on main line 21.2 miles west of KCW) and to remodel the existing Mentowkow branch, so that it can be used as a part of the main line, extending it through Tsingpeikou, Chuwokou, Shihchiachwang and Yenchiakou, and rejoining the main line at Shacheng. This new line closely follows the upper course of the Yungting River, and, according to the report submitted by the Locating Engineers, the ruling grade could be made as low as half per cent. For the general plan and profiles, comparing the existing main line with the proposed new line, see Figs. 1, and 5. The cost of constructing this new line was estimated in 1924 to be somewhere about $17,000,000 (Mexican), and, as the cost of materials and the wages of labor are considerably higher nowadays, the estimate when revised will probably be well above $20,000,000.

Of the three proposals, the last one (C) is perhaps the best and most suitable to the traffic requirements; but, as the PSR is in a very stringent condition financially, it is simply impossible now to raise a fund of $20,000,000 for carrying out the work. This will have to wait until a better opportunity comes later on.

The only feasible scheme that can be considered at present, is to replensih air brakes on PSR cars, as well as hand brakes on foreign line cars that now remain on PSR, and to install air brakes on, say, one third of the latter cars, with the other two thirds equipped with air pipes so that compressed air can be connected up throughout any train, thus allowing increase of the loads that can be safely hauled by locomotives now running in the Pass. This is a measure which will only temporarily relieve the present difficulties to some extent. Eventually, the question of relocation must be taken up when the financial condition of the PSR will permit.

Manufacture of Submarine Telegraph and Telephone Cables in Japan

(Continued from page 470)

the application of three layers of coating in one operation. Furthermore, due to the absence of the chatterton compound between the layers, electric characteristics are greatly improved. This is particularly true in case of telephone cables which involve high frequency transmission.

The gutta percha insulated wire which constitutes a core of a submarine cable is subjected to hydraulic pressure of 600 atmospheres, after being left standing for two weeks. It was designed and made by Sumitomo Steel Works with special steel. The tank is reinforced by the bands of forged steel tires, shrank fit to the cylinder. Taping machines, jute serving machines and armoring machines were all designed by the Company, basing processes on their long years of experience and were manufactured by local manufacturers.

The most outstanding difference in the requirements of a submarine cable factory as compared with other cable plant is that the former requires large capacity reservoir tanks for storing extremely long cables under water. Under the present practice, the submarine cables are manufactured, or transported in one continuous length so that it is not unusual to have a cable length as long as several hundreds of nautical miles. As for the means of transportation, there is no other than by cable ship. For this reason, when an appropriate cable ship is not available, it is necessary to store the cable for a considerable length of time. Sumitomo Submarine Cable Works is equipped with several tanks of such large capacity, with ample space for future extension.

The wharf provides about 150 meters of berth by the side of these tanks for cable ships. Attention was given when the *Okinawa Maru* moored at the wharf the first time and it was observed that loading work was performed with extreme ease as anticipated.

Finally, special mention is required to be made of the equipment for the paragutta preparation. As is well known this paragutta is the product of ten years of unfaltering efforts of Dr. Kemp under the supervision of Dr. Jowett of the Bell Telephone Laboratories and an expenditure of one million gold dollars for research. Paragutta may be described as a product obtained by blending refined rubber and deresinated gutta percha or balata mixed with a special wax. It is waterproof and extremely durable. As has been published by Dr. Kemp in technical institute papers its dielectric loss in case of high frequency is extremely small and the general properties as an insulating material are excellent. Had it not been for the development of this material, plan and design of transatlantic submarine telephone cables was technically impractical. It is a well known fact that the recent submarine telephone cable of this type manufactured by Felten Guillaume Co., of Germany, laid between Key-West and Havana is operating with carrier system. Sumitomo Submarine Cable Works is completely equipped with such necessary equipment for paragutta insulated submarine cable manufacture and has already commenced experimentation. Therefore, results will be published ere long

Chiaotung University Where China's Young Engineers are being Trained

(Continued from page 468)

have been planned to impart to students a broad and general knowledge of the principles and methods of science, administration and engineering Graduates will therefore find it comparatively easy to secure employment in the various educational, government, industrial, and commercial pursuits.

The policy of the University is to recommend all the graduates to the Ministry for employment as student-apprentices in the different departments of the National Railways and Telegraph and Telephone Administrations. Many of the University graduates may be found working in these Government administrations.

Engineering Notes

INDUSTRIAL

EXPERIMENTAL TEA FACTORY.—The erection of an experimental tea factory has been undertaken at Serdang by the F.M.S. Department of Agriculture, and a considerable area of the land at the Cameron Highlands Experimental Plantation has been laid out as nurseries for recently imported tea seed. Developments here will be watched with interest.

KRAFT PAPER FACTORY.—The Japan Rayon Company has decided to build a factory for manufacturing 40,000,000 pounds of kraft paper a year. The factory is at Shikika in Saghalien. Kraft paper is in heavy demand as wrapping paper. The Fuji Paper Company, the only concern producing this kind of paper in Japan, has an annual capacity of 20,000,000 pounds.

MITSUI AMMONIATE FACTORY.—Plans to manufacture ammonium sulphate have been announced by the Mitsui interests. The concern, styled the Toyo Koatsu Kogyo Kabushiki Kaisha, or Oriental High Pressure Industry Co., Ltd., will have a capital of Y.20,000,000. The factory will be built adjacent to the Miike Nitrogen compound, and will use air fixation methods. Annual output is estimated at 120,000 tons.

CANNING FACTORY FOR MALAYA.—The Malayan Government is devoting attention to the pineapple canning industry, and plans are ready for a model estate and canning factory in Selangor. Thanks to an intensive campaign, no less than 911,000 cwt. of canned and bottled pineapples were exported to the United Kingdom during 1932, which is a 33 per cent advance on the previous record figures of 685,000 cwt. in 1931.

COMMUNICATIONS

JEHOL ROAD MAKING.—Construction of roads being a primary consideration in Jehol in view of the existing primitive stage of transport facilities, the State Highways Bureau has started to build highways between Peipiao and Chengtch'and between Chaoyang and Chihfeng. On their completion, some time during the latter part of this year, motor traffic will be opened. Other modern means of transportation are also being studied.

CANTON TRAMWAY.—Plans approved by Canton Municipal Government, to be carried out at once, give the city new commercial, agricultural, residential and amusement areas, and call for the construction of tramway lines, aerodromes, railway stations and maloos. Considerable interest attaches to the tramway project as despite its large size Canton is without a tram service. A tramway covering many of the principal thoroughfares was laid over ten years ago, but on account of a dispute between the company and the Government, the service was never inaugurated.

ROAD BUILDING IN CHEKIANG.—The whole of the Hweichow Valley section of Chekiang Province is alive with road makers. Shuenan is to be connected up with Hweichow, and before the end of the year the motorist is promised a round trip from Hangchow via Yuhang, Changhwa, Chihchi, Shihhsien, Shuenan Kienteh and thence via Tonglu and Fuyang back to Hangchow. The craze for the motor car, says a correspondent, is like a hind let loose. The Central Government has decreed that all county towns must be linked by modern roads, and evidently these commands are meant to be obeyed.

RAILWAYS

MANCHOUKUO RAILWAY.—The inhabitants of Paotsing district have petitioned the Manchoukuo authorities to construct a railway from Lishuchen to Paotsing, 130 miles. They point out that the district is very fertile and that the scheme, if carried into effect, will prove profitable.

KIANGSI RAILWAY SCHEME.—A project for the construction of a railway between Yushan and Pinghsiang, in Kiangsi, has been examined and will be brought up at the next meeting of the Chinese Executive Yuan. The projected line, which will stretch across north Kiangsi, will be of commercial and strategic importance.

NEW KWANGSI RAILWAY.—Preparations for the construction of the Samshui-Hohsien Railway, an extension of the Canton-Samshui Railway to Kwangsi, are making substantial progress. A preliminary survey of the line is being undertaken and the Liang-Kwang authorities hope that this work will be completed within two months.

LOCOMOTIVES ORDERED.—An important Chinese engineering order has come to Leeds. The Hunslet Engine Company, Ltd., Jack Lane, have been commissioned to build six locomotives for the Hongchow-Kiangshan Railway.

The order has been placed by the Chinese Government Purchasing Commission under Dr. Wang—in connection with the Boxer Indemnity scheme—and it is for six 480 super-heated double bogey engines.

It follows closely on the completion of a heavy tank engine which the same firm have just delivered for use at the Pukow Ferry.—

SULZER BROTHERS

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4 AVENUE EDWARD VII.

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THE FAR EASTERN REVIEW

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ORIENTAL IMMIGRATION IN BRITISH COLONIES AND DOMINIONS

JAPAN'S FOREIGN POLICY

A JAPANESE TALKS TO AMERICA

Vol. XXIX | NOVEMBER, 1933 | No. 11

Engineering Notes

INDUSTRIAL

MUKDEN ARSENAL.—In furtherance of its plans for the development of industry, the Manchukuo Government has decided to convert Mukden Arsenal to the manufacturing of harvesting, commercial and industrial implements. These are considered urgent, and the provincial authorities are advancing Y.150,000 for a start.

PAPER MILL FOR CHEKIANG. Tsingtien, near Wenchow, in Southern Chekiang, is favored for the establishment of a paper mill, according to technical experts of the Ministry of Industry, who recommend the quality and abundance of raw materials available and the practicability of installing a hydro-electric power plant.

MANCHOUKUO CEMENT. Mr. S. Kitabayashi, formerly with the Asano Portland Cement Co., has obtained the sanction of the Manchoukuo Government for establishment of a cement company in Manchuria under joint management of Japanese and Manchurians. The company will be capitalised at Y.5,000,000, half to be paid.

FORMOSAN PAPER WORKS. Mr. Heizaburo Okawa, former president of the Fuhi Paper Company has decided to establish the Taiwan Paper Business Company with a capital of Y.5,000,000 totally paid by himself. The new company, unlike existing companies using pulp, intends to use waste Formosan sugar cane for making printing paper.

BEER PLANTS FOR KOREA. Dai Nippon Brewery, Tokyo, has decided to erect a plant with an annual capacity of 100,000 boxes at Eitoho, near Seoul, and work is in progress. When the plant is completed a subsidiary will be established to operate the new brewery with a capital of Y.6,000,000. Kirin Beer also is building a plant with similar capacity at the same place. The operating company will be the Showa Kirin Company. Consumption of beer in Korea has been gaining recently, due to the greater purchasing power of the population.

CEMENT WORKS FOR MALAYA.—The chairman's speech at the Malayan Collieries meeting referred to the probability of developing a cement industry as a subsidiary. By far the largest and most important undertaking which we have under consideration is, he said, the proposed cement works, with quarry and transportation system. Proposals have been submitted to the Government, and meantime, pending the decision, everything short of placing contracts has been done. Technically, the works under consideration will be quite the last word in efficiency. A member of the board will shortly confer with consulting engineers in London and with the principal tenderers for the supply of the plant.

FISHING STATION PLANNED. An appropriation of Y.10,000,000 for five years' work in the establishment of a permanent fishing base at Horomushiro Island in the Kurile group is to be included in the coming Japanese budget. The first year's appropriation will be about Y.300,000 and will be used for surveys and plans. A permanent base is considered essential for large-scale Japanese fishing. At present about 400 operators employ more than 20,000 fishermen, and they have been forced to go to Hakodate and Otaru for provisions and equipment, necessitating a ten-day voyage each way. For a permanent station on Horomushiro plans are nearly complete, and five years will be required because laborers are prevented by frigid temperatures from working more than five months of the year. The base will have a spacious harbour, coal depot, water supply station, ship-landing piers and warehouses on a large scale.

RAILWAYS

NEW RAILWAY IN MANCHURIA. The Manchoukuo communication authorities are constructing an important railway, 268 kilometers long, to link Harbin and Lafa in north Manchuria. A statement indicates that the new line will not only open up the rich central part of Heilungkiang, but will also form a trunk line of various railways in the future.

INDO-CHINA RAILWAY.—Some time ago the French authorities took up the question of electrifying several railways in their colonies, and also constructing new electric lines. Detailed estimates for the Indo-China, Saigon-Mytho, and Hanoi-Santay lines are now before the French Minister for the Colonies, who is expected to announce his decision shortly.

SHANSI RAILWAY EXTENSION.—It is reported that Yen Hsi-shan, Governor of Shansi, is definitely inviting tenders from European firms for permanent way equipment for the first section of the Tung-Pu (Tatung-Puchoufu) Railway, that is from a point about 60 miles north of Taiyuan to Chichsin, south of Yu Tzu, a total distance of 120 miles. A small commission, the members of which are foreign trained, has been sent to Europe to study and report on railway matters generally.

ELECTRICAL

POWER PLANT FOR KOREA. Mr. Jun Noguchi, president of the Japan Nitrogen Company, and Chosen Nitrogen Company, has decided to establish a water power electric company with a capital of Y.20,000,000 on the Choshinko River in Korea. The enterprise was first planned by the Mitsubishis. The concern aims at generating about 320,000 kw. of power.

POWER PLANTS FOR JEHOL.—Plans are under way for the establishment of electric power stations at suitable places to supply electric light and power to various parts of Jehol Province. At present electric light is supplied only at Chihfeng. The power house at Peipiao will be restored to its full capacity of 1,500 kilowatt, and electric current will then be transmitted to Chaoyang and Peipiao. As regards telegraphic and telephone services, a new line is being put up between Chaoyang and Chihfeng.

JAPANESE DEVELOPMENTS.—The railway authorities have decided to complete the power station construction program on the Shinano River not later than the fiscal year 1939-1940. First it is proposed to build the No. 1 Chitose station at a cost of Y.28,000,000. This station, having a capacity of 44,000 kw. is to be completed in the year 1938-39, a commencement being made with the No. 2 Chitose station (40,000 kw.) in the following year. The I.G.R. has also decided to press forward with the construction of the 62,000 kw. Okuniyama station with a view to completing it by August, 1935.

COMMUNICATIONS HIGHWAYS IN CHINA.—General Chiang Kai-shek has given instructions for highway engineers to proceed at once to Kiangsi to complete several roads on which work has been going on for months. It is understood that tools, machinery, and light railway tracks and trucks in large numbers are being transported to different points. Only recently in Nanking, at a special road conference with delegates from the seven central provinces of China, the National Economic Council was entrusted to carry out the completion of 20,000 kilometers of highways involving a total expenditure of over $100,000,000. Work on some of these highways has already started, and it is expected that next year will see its completion.

JAPANESE ELECTRIFICATION.—Estimates have been prepared for the I.G.R.'s proposed railway electrification schemes for the year 1933-34. A sum of Y.1,803,033 is to be spent on the Kodzu-Numadzu section of the Tokaido line, and transmission lines will be erected between Yugawara and Mishima and between Atami and Numadzu, with substations at Mishima and Yugawara. On the Iidamachi-Chiba section Y.909,600 will be expended, and other lines to be electrified are the Uyeno-Senju, Shinagawa-Tsurumi, Kofu-Nirashima, and Haramachida-Hachiojo sections, for all of which, however, the appropriations for the year are comparatively small.

SHIPPING

STEAMERS FROM ENGLAND.—The China Merchants S.N. Co.'s proposal for a loan of £360,000 for the purchase of six new steamers was approved by the Trustees of the British Boxer Indemnity Fund on June 5. According to Shanghai shipping circles, the six steamers the China Merchants propose to purchase from England include four sea-going vessels and two vessels for river service. Three of the seagoing vessels would be of 3,500 tons each and one of 3,000 tons, while the two river ships would be of 3,500 tons each.

PORT DEVELOPMENTS IN CHINA. Kiangsu Provincial Government is contemplating the development of Laoyao and Hsukow, on the northern Kiangsu coast, as trade areas. It is anticipated these places will gain considerable commercial importance with the completion of the eastern extension of the Lung-Hai Railway. Construction of this extension has been completed as far as Hsukow. The next task is the tunnelling of Sunhia Hill, between Hsukow and Laoyao on the coast. The latter town is the projected site of Haichow harbor.

BILLION YEN CANAL SCHEME.—Nagoya plans the construction of a ship canal 62 miles long, linking Nagoya with Tsuruga, on the Japan Sea. The idea is to have direct connection with North Korea and Manchuria. The canal would be 115 kilometers long, but would use Lake Biwa for 25 kilometers. The difficulty, of course, is that construction of the canal, longer than either the Suez or Panama canals, would cost an immense sum, but the city fathers are hopeful that if the Government decides on large-scale public works to aid the unemployed it will consider this project seriously.

COMMUNICATIONS

TRAMS FOR NANKING.—Three routes have been mapped out by the Reconstruction Commission as the beginning of a tramway system for Nanking. The routes will traverse the busiest sections of the city. The tram lines will be laid down in three stages at a cost of approximately 13 million dollars. The Reconstruction Commission of Nanking has addressed a communication to the Trustees in charge of the British Boxer Indemnity Refund requesting a loan of $3,000,000 for the project.

MORE BRIDGES FOR CANTON. With the gigantic bridge across the Pearl River joining the Honam Island to Canton City proper, now in use, the Canton municipal authorities are contemplating the building of a second bridge to cross the river from the West Bund. Yet another bridge is under consideration to link up Canton and Fati. This bridge, which is to be built jointly by the Municipality and the Canton-Hankow Railway Administration, has passed its initial stage, and in fact a provisional contract has been awarded to Messrs. McDonnell and Gorman, the same contractors who built the bridge just finished.

ENGINEERING FINANCE COMMERCE

THE FAR EASTERN REVIEW

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上海黃浦灘念四號

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New Motor Vessels in Service in China

The Whangpoo Conservancy Board, Shanghai, has put a motor vessel in service for carrying cargo on the Whangpoo and Soochow Creek. It is 54-ft. long and displaces about 45 tons when carrying a load of 20 tons. At the trials the vessel (Fig. 3) which is equipped with an airless injection four-cylinder Sulzer Diesel engine developing 50 b.h.p. at 550 revs per min., attained a speed of 8.1 miles per hour, the guaranteed speed being 6.5 knots. When travelling at full speed it can be brought to rest in about 40 seconds.

Another vessel put in service at Shanghai is the passenger boat *Soy Yun* (Fig. 1), for conveying workmen and other employees between the dock and vessels under repair. It is in service for about eight hours daily. The vessel, which is 44-ft. long and has a speed of nine knots, was built by the New Engineering and Shipbuilding Works and is equipped with a 160 b.h.p. airless-injection three-cylinder Sulzer Diesel engine.

The same company has also put the tug *Geisha* into service, which is subject to very severe manœuvring service on the Whangpoo and is preferred to other vessels equipped with hot bulb engines on account of its being quickly ready for service. The vessel (Fig. 2) has a length of 61-ft. and is equipped with a 160-b.h.p., airless-injection Sulzer two-cycle Diesel engine which gives it a speed of 9.4 knots.

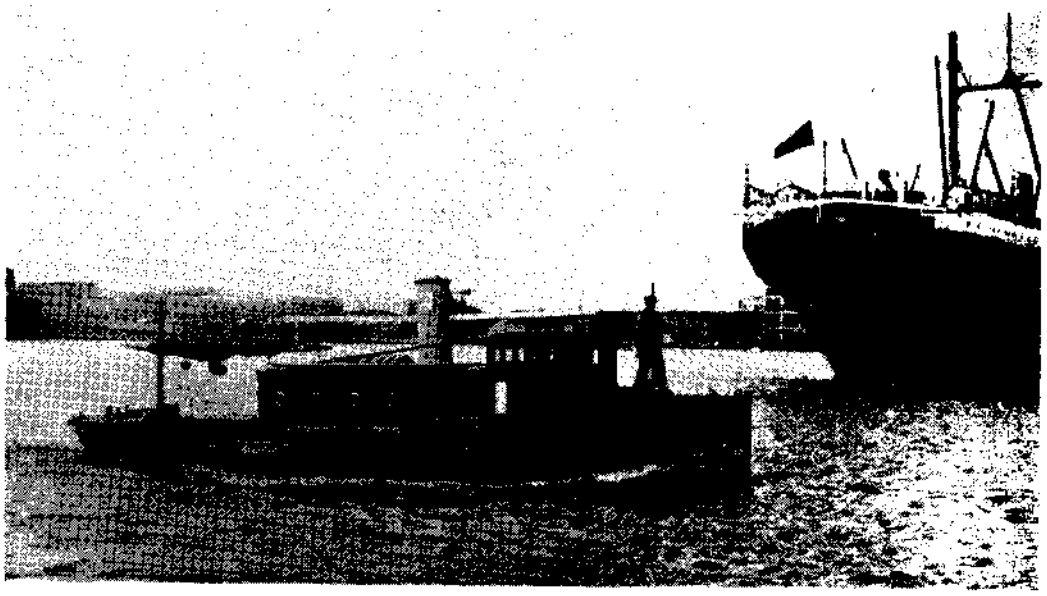

Fig. 1.—Tug Boat "Soy Yun," built by the New Engineering and Shipbuilding Works, Shanghai, and propelled by one Sulzer Marine Diesel Engine, 160 b.h.p. at 375 r.p.m.

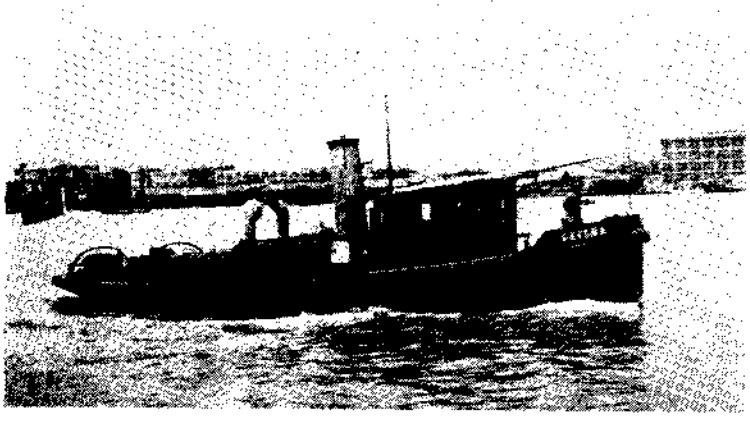

Fig. 2.—Motor Tug "Geisha" propelled by a Sulzer Airless injection 2-cycle Diesel engine developing 160 b.h.p. at 375 r.p.m.

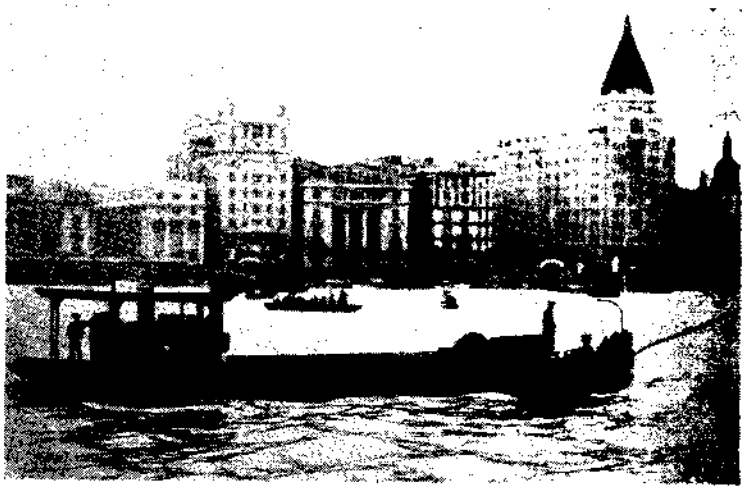

Fig. 3.—Motor cargo boat of Whangpoo Conservancy Board, Shanghai, propelled by a Sulzer 2-cycle Airless Injection Diesel Engine Type 4-RKW-15, developing 50 b.h.p. at 550 r.p.m.

Railway Construction in Hunan

About $6,600,000 is to be spent on the Paoking-Hungkiang light railway, in Hunan province, out of a loan of $10,000,000 to be raised shortly. Two-thirds of the proceeds are to be used for the repair and completion of the Paoking-Hungkiang Railway, and will be controlled by a Special Custody Committee in order to prevent funds being appropriated for other uses.

Surveying of the route of the railway, as well as all matters relating to planning and technical affairs, shall be undertaken by the Ministry of Railways. The Ministry shall appoint competent men to take charge of the engineering work for repair and completion of the railway.

In case of necessity, the Ministry of Railways shall have the right to take over the railway upon payment of equitable compensation to the Provincial Government.

A set of general principles governing the flotation of the Hunan Provincial Reconstruction Loan was adopted at a meeting on October 18, of the Central Political Council. Following is a summary of these principles :—

(1) The amount of issue shall be fixed at $10,000,000.

(2) One-third of the total proceeds shall be used for the repayment of previous loans granted by the banks; and the remaining two-thirds for the repair and completion of the Paoking-Hungkiang light railway.

(3) Interest shall be at the rate of 6 per cent per annum.

(4) The principal of the loan is to be entirely redeemed within a period of ten years.

(5) The revenues accruing from the Provincial Business Tax and Certificate Tax in southern Hunan shall be earmarked as primary security; and the earnings of the Paoking-Hungkiang light Railway as secondary security for the repayment of the loan.

The amounts required for the service of the loan shall be deposited regularly with the Bank of China, Bank of Communications, Shanghai Commercial and Savings Bank, and Provincial Bank in southern Hunan to the account of a Sinking Fund Committee, composed of Government officials and financial and industrial leaders designated by the Executive Yuan.—*Chinese Economic Bulletin.*